MONTHLY WEATHER REVIEW,

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(General Weather Service of the United States.)

WAR DEPARTMENT,

Office of the Chief Signal Officer,

DIVISION OF

TELEGRAMS AND REPORTS FOR THE BENEFIT OF COMMERCE AND AGRICULTURE.

INTRODUCTION.

In preparing this REVIEW the following data, received up to June 20th, have been used, viz: the regular tri-daily weather charts, containing the data of simultaneous observations taken at 133 Signal Service stations and 15 Canadian stations, as telegraphed to this office; 197 monthly journals and 174 monthly means from the former, and 15 monthly means from the latter; 212 monthly registers from Voluntary Observers; 58 monthly registers from United States Army Post Surgeons; Marine Records; International Simultaneous Observations; monthly reports from the local Weather Services of Iowa, Nebraska and Missouri, and of the Central Pacific Railway Co.; reliable newspaper extracts; special reports.

BAROMETRIC PRESSURE.

The distribution of mean atmospheric pressure over the United States and Canada for the month of May, 1881, is shown by isobaric lines (in black) upon Chart No. II. The area of low pressure, which remained about central over New England and the Canadian Maritime Provinces during the past three months, has now disappeared, being replaced by pressures ranging from 30.05 to 30.11, which are the highest on record for any June since 1874, and together with the Northern Pacific coast, are the regions of highest pressure for the month. The regions of lowest pressure occupy the Upper Mississippi and Lower Missouri valleys and California. Compared with the preceding month, the pressure is considerably higher east of the 87th meridian, ranging from +0.05 to +0.46, while to the westward of that boundary a decrease is observed, ranging from —0.02 to —0.14. Compared with the same month in previous years, the disposition of pressure is very much the same, except the remarkably high area over the Canadian Maritime Provinces. Heretofore the pressure has averaged about 29.95 in this section, while the high areas were common to the Northern Pacific coast and the Eastern Gulf States. It is interesting to note in this connection that in the preceding month (April) the lowest pressures for many years, prevailed over the Canadian Maritime Provinces, while in the present month, the reverse prevails to even a greater degree.

Departures from the Normal Values for the Month.—The pressure is everywhere above the normal, except in the Gulf States (excluding Texas) Florida and along the Pacific coast. From the interior of the country the departures increase to the east and west, the areas of greatest deviations coinciding with the regions of highest and lowest pressure, viz: New England and the Missouri valley. Along the Atlantic coast the departures steadily increase from —0.01 inch at Jacksonville to +0.13 inch at Eastport and on the summit of Mt. Washington, the latter being the largest reported for the month. Over the interior the departures increase from —0.01 inch at New Orleans to +0.10 inch at Bismarck, while along the Pacific coast the reverse prevails as you pass northward, diminishing from —0.07 inch at San Diego to —0.01 inch at Portland, Or. At Rocky Mountain stations a variation is shown as follows: from +0.04 inch at Santa Fe to +0.08 inch at Cheyenne and Pikes Peak. Salt Lake City reports a change of +0.01 inch, Key West, —0.03, and Punta Rassa —0.07. Stations maintaining a normal condition are as follows: Galveston, Ft. Gibson, St. Vincent and Wilmington.

Barometric Ranges.—The range of pressure during the month has varied in the extremes from 0.2 inch at Campo, Cal., to 1.01 inches at Moorhead, Minn. In general the range varies from 0.4 to 0.7 inch. Ranges of 0.9 and above were reported from the following stations: North Platte, 0.97; Burlington, Vt., and St. Vincent, 0.96; Alpena, 0.94; Yankton and Albany, 0.93; St. Paul and Oswego, 0.92; Springfield, Mass., and Rochester, 0.91; Marquette and Escanaba, 0.9. Ranges of 0.35 and below were reported as follows: San Diego, 0.23; Los Angeles, 0.24; Tucson, 0.26; Ft. Grant, 0.27; Florence, 0.28; El Passo, 0.29; La Mesilla, 0.3; Camp Thomas, Ariz., 0.31; Ft. Davis, Texas, and Key West, 0.32; San Francisco, 0.34; Sacramento, 0.35. Along the eastern and western coasts of the country the range increases with the latitude. Over the southern boundary the range increases from the southwestern and southeastern extremes (California and Florida) to the maximum in Texas, and along the northern boundary from the northeastern and northwestern extremes (Maine and Washington Territory) to the maximum in Minnessota. It is interesting to note that the region of greatest range (the Red River of the North Valley) coincides with the region of least departure from the normal, showing that a considerable variation of pressure for the month of May is consistent with the peculiarities of this region. The region of the greatest departure from the normal (the New England coast, particularly Maine,) coincides with the region experiencing but a moderate range in pressure, which for the month of May is not usual, as the variations of pressure in New England are generally among the largest of the country.

Areas of High Barometer.—Six such areas, during the month of May, have been sufficiently marked to merit description. The minimum temperatures for the month occurring in the Northwest on the 2d; in the Lake region on the 2d, 3d and 4th; in the Ohio valley on the 3d and 4th; in New England and the Middle Atlantic States on the 4th and 5th, are associated with high-area No. I. The minimum temperatures in Tennessee, the East Gulf and southern portion of the South Atlantic States occurring on the 18th and 19th, are associated with a depression then central off the South Atlantic coast.

No. I.—This area, which was described as high-area No. V in the April REVIEW, was central in the Middle Atlantic States at midnight of April 30th. It moved southward during the 1st of May and, at midnight, was off the South Atlantic coast. During the 2d the pressure gradually diminished in the South Atlantic States.

No. II.—At the morning report of May 1st, the pressure was above the normal at all stations east of the Rocky Mountains, excepting Marquette and Escanaba and an area of high barometer was approaching the Lake region from the Northwest, where the pressure was 0.2 inch above the normal. This area moved slowly eastward and, on the morning of the 2d, was central in Manitoba as an area of 30.4 inches. During the 2d the temperature fell decidedly in the Lake region. Continuing its eastward movement the area was central on the morning of the 3d in Ontairo, when the isobaric line of 30.4 inches embraced the whole of the Lake region, where the temperatures were from 12° to 19° below the normal. The lowest temperatures reported were 26° at Alpena and 32° at Duluth. On the morning of the 4th, the area of 30.4 inches embraced New England, the Middle Atlantic States and the greater portions of the Lake region and the Canadian Maritime Provinces. The temperatures continued below the mean in all districts east of the Rocky Mountains, excepting the Gulf States. During the 5th and 6th the pressures on the North Atlantic coast gradually decreased, the area moving eastward and disappearing on the latter date. Cautionary Signals were ordered up on the morning of the 3d, from Delaware Breakwater to Cape Hatteras. They were lowered at Chincoteague and Delaware Breakwater at midnight of the 3d, and on the North Carolina coast on the morning of the 4th, having been fully justified.

No. III.—This area appeared in the St. Lawrence valley at midnight of the 7th, and moving in easterly direction during the 8th and 9th, caused easterly winds and local rains in the Canadian Maritime Provinces and New England. At midnight of the 9th it had disappeared.

No. IV.—During the 11th the pressure rapidly increased in the extreme Northwest, and on the morning of the 12th an area of high barometer was central in the northern portion of the Missouri valley, where the barometer was 0.3 inch above the normal. Following in rear of low area No. II this area moved across the Lake region and up the St. Lawrence valley, and at the afternoon report of the 14th had disappeared. In advance of this area the temperatures in the Lower Lake region, the Middle Atlantic States and New England were extremely high. On the 11th and 12th a decided fall occurred in the Mississippi and Missouri valleys, and on the latter date in the Lake region. An abnormal fall of 33° in eight hours was reported from Port Huron at Midnight of the 12th. The maximum temperatures for the month in the Middle Atlantic States occurred on the 13th, at which time the high area was in the Lake region, and the winds in the Middle Atlantic States were northwesterly. The temperature fell decidedly on the 14th.

No. V.—At the morning report of the 15th the pressures east of the Mississippi were below the normal. During the 15th the pressures recovered in the Lake region, New England and the St. Lawrence valley. The barometer continued to rise rapidly in the Canadian Maritime Provinces during the 16th, and an area of high barometer remained nearly stationary in the Gulf

of St. Lawrence during the 16th, 17th, 18th and 19th. On the latter date the pressures diminished somewhat, but recovered by the morning of the 20th, and continued high until midnight of the 21st, after which time the pressures decreased. This area, in connection with low areas Nos. III and IV caused strong northeasterly winds and heavy rains in New England and the Middle Atlantic States from midnight of the 15th until the 22d. Cautionary Signals were ordered up at Eastport, Portland, Boston and Wood's Holl at midnight of the 16th, and the signals ordered in advance of low area No. III from Chincoteague to New Shoreham were kept displayed until the afternoon of the 17th, when lowered. The signals on the New England coast were lowered on the afternoon of the 19th. All signals were justified by the following maximum velocities: Eastport, NE. 55 miles; Portland, NE. 32; Boston, NE. 36; Wood's Holl, NE. 28; Thatcher's Island, NE. 44; New Shoreham, NE. 48; Sandy Hook, NE. 26, and Chincoteague, NE. 28.

No. VI.—The pressures remained above the normal east of the Mississippi after the passage of area No. V. During the 22d the barometer rose in Canada, and on the morning of the 23d a high area, of 0.3 inch above the normal, was central north of Montreal. This area moved slowly eastward, and at the afternoon report of the 26th was central east of the Canadian Maritime Provinces. On the 27th it had disappeared.

Areas of Low Barometer.—Five such areas are charted for the month of May. Nos. IV and V are specially interesting from the unusual paths pursued by them. None of the storms charted displayed particular energy.

No. I.—On the morning of the 1st the barometer was above the normal at all stations east of the Rocky Mountains, excepting Marquette and Escanaba, and a depression of slight energy was central over Lake Superior. Light rain and cloudy weather prevailed in the Upper Lake region and in the Lower Missouri and Upper Mississippi valleys; elsewhere in the United States the weather was fair. The pressure diminished rapidly in the St. Lawrence valley during the 1st, and the depression moved eastward, north of the Lake region, and was central in the St. Lawrence valley at midnight. It crossed the Canadian Maritime Provinces during the 2d, and at the morning report of the 3d it had disappeared. In rear of this depression and in advance of high area No. II cautionary signals were ordered up at midnight of the 1st at Escanaba, Milwaukee, Grand Haven and Chicago. They were lowered at midnight of the 2d, having been justified at all stations excepting Chicago. This area caused rain in the Northwest, the Lake region, the Ohio valley and Tennessee, New England and the Middle Atlantic States. The weather cleared on the 1st in the Northwest and, on the 2d, in the Lake region and New England. Light local rains continued in the Middle Atlantic States until the 4th.

No. II.—The pressures remained low in the Northwest and in Manitoba from the 5th until the morning of the 11th, at which time an area of 29.7 inches was central in Minnesota. Cloudy weather and light rains were reported from the extreme Northwest; elsewhere in the United States fair weather prevailed. This depression, moving northeastward to Lake Superior, and thence eastward, was central near Montreal at midnight of the 12th. At the morning report of the 13th it had disappeared. This area was not accompanied by high winds. It caused light rains in the Upper Lake region during the 11th and 12th, and in New England on the latter date.

No. III.—During the 12th and 13th the barometer fell slowly in the extreme Northwest and on the afternoon of the 13th a depression was central north of Fort Buford. Cloudy weather and rain prevailed in the Lake region and in the northern portion of the Upper Mississippi valley during the 13th, and the depression taking a southeasterly course was central north of St. Paul on on the morning of the 14th; thence the depression moved eastward and at midnight was north of Saugeen. During the 15th it moved southeastward and at midnight was central in New Jersey; thence it continued its southerly course and passed to the east of the South Atlantic coast, where the pressure remained below the normal until the 17th, on which date low area No. IV commenced to move northward. This area caused light rains in the Lake region, New England and the Middle Atlantic States. It did not exhibit much energy within the limits embraced in the weather maps. High winds were reported from the Lake region on the 15th. The cautionary signals displayed on the Atlantic coast have been considered in connection with high area No. V.

No. IV.—This area was probably a secondary development of No. III. During the 16th and 17th the barometer continued low on the South Atlantic coast, and threatening weather, with rain, continued in New England and the Middle Atlantic States, in which districts the winds were under the influence of high area No. V, which was in the Gulf of St. Lawrence. On the morning of the 18th a depression was central southeast of Cape Hatteras. At this time cloudy and rainy weather, accompanied by strong northeasterly winds, prevailed from Eastport, Me., to Cape Lookout. The cautionary signals which had been hoisted from Eastport to New Shoreham on the 16th were kept displayed. During the 18th the depression moved northward, and at the afternoon report was east of Cape May. Thence it moved westward, and at midnight was central west of Barnegat, and on the morning of the 19th was west of Philadelphia. Thence it moved north to Ontario; was northwest of Rockliffe on the morning of the 20th, and afterwards remaining nearly stationary, gradually filled up.

No. V.—On the morning of the 28th this area was central in the western portion of Minnesota. Light rains were reported from the Missouri valley, and heavy rains, accompanying thunder storms, from Texas. The depression moved slowly southward during the 28th, and on the morning of the 29th was southwest of Omaha, where it remained stationary until midnight. On the morning of the 30th it was southwest of Leavenworth; at the afternoon report it was central in Indian Territory. During the 31st it moved to Southern Texas, where it ceased to exist as an independent depression.

INTERNATIONAL METEOROLOGY.

Two International Charts, Nos. V and VI, accompany the present REVIEW. The former, prepared for the month of June, 1877, is published in accordance with an explanation given in the leading paragraph under *International Meteorology* in the January, 1881, REVIEW. The barometric pressure over India, which, beginning with the chart for January, 1877, was indicated by isobars in broken lines copied from the "Report on the Meteorology of India for 1877," published by the government of that country, has, for the present month (June, 1877), been prepared from the data of simultaneous observations which were commenced by the Government of India on the first of that month. Chart No. VI is for June, 1879, and continues the series of this chart begun in October, 1877.

Chart No. V, shows the mean pressure, temperature, wind force and the prevailing direction of the wind at 7.35 a. m. Washington, or 0.43 p. m. Greenwich, mean time, for the month of June, 1877, over the northern, and at certain isolated stations in the southern hemisphere. The area of lowest pressure covers northwestern Siberia, extending thence eastward over the extreme northern portion of Russia and Scandanavia and still farther eastward to Iceland and Greenland. The low area over Siberia appears to have been the result of a gradual translation northeastward of the low pressure of the previous month of *May*, which during that period occupied the region just north of the Black Sea. The depression over Iceland and Greenland appears to have resulted from a movement to the northeastward of a low pressure area, which in *May* prevailed over the Canadian Maritime Provinces. These two individual movements, pursuing almost parallel paths to the northeastward, appear to have combined their influences over the Arctic Ocean to the northward of Europe, affecting thereby in a marked manner the mean pressure over considerably more than 180° of longitude. The pressure is low throughout the interior of Asia and along the Asiatic coast. Over the United States the area of low extends northward from Texas to British America and thence eastward to Canada and the Maritime Provinces. The lowest pressures of the month were reported from the following stations: Yeniseisk, 29.65, (753.1); Ekaterinburg, 29.69 (754.1); Tromso, 29.70 (754.4); Godthaab, Stykkisholm, Kasan and Archangel, 29.74 (755.4); Barnaul, 29.75 (755.7). The area of highest pressure, except at isolated stations, occupies Algeria and probably extends thence westward into the Atlantic. The isobar of 30.00 incloses southwestern Europe while considerably higher pressures occur at isolated stations in Prussia, Turkey and Italy. Over the United States this isobar covers the southeastern portion, including the Gulf and South Atlantic States, Tennessee and the lower half of the Middle Atlantic States. Pressures of 30.10 and above were reported from the following stations; Melbourne, 30.34 (770.5); Ponta Delgado, 30.21 (767.2); Mauritius, 30.20 (767.1); Kingston, Jamaica, and Angra, 30.17 (766.2); Cape Town, 30.15 (765.7); Portland, Or., Mexico and Honolulu, 30.13 (765.3); Valona, 30.14 (765.5); Funchal, Tabessa and Laghouat, 30.12 (765.1); Breslau, Sfax and Geriville, 30.11 (764.7); Frankfort-on-the-Main, 30.10 (764.5). The extreme monthly range of mean pressure is 0.69 inch, the largest since *February* and nearly double that of *May*. The lowest temperatures, given in Fahrenheit's scale, were reported from the following stations: York Factory, 38°; Gothaab, 44°; Stykkisholm, 46°; Ft. St. Michaels and Nikolaievsk, on the Amoor, 47°. In this connection it is desired to call attention to an error in calculation which occurred in obtaining the mean temperature of York Factory for *May*. It should have been entered 36°.5 instead of 43°, as indicated upon the chart for that month. The highest temperatures were reported from northern India and central Algeria, in the former ranging from 95° to 101° and in the latter from 85° to 97°. The prevailing direction of the wind was *variable* over the United States west of the 100th meridian, in the Lake region and in Canada, *southerly* over the interior, and *southwesterly* along the Atlantic coast. Over Europe, *southwesterly* along the coast and to a considerable distance inland; beyond the 10th meridian *east* and in Algeria *north* and *northwest*. Over Asia *variable* and in India *southwest* to *west* and *northwest*. Compared with the preceding month there has been a general rise in pressure over North America south of parallel 50°, ranging from +0.02 to +0.11 inch, while to the northward the decrease has been quite marked, being —0.16 inch at York Factory. Over Europe south of parallel 60° the increase in pressure has been quite large, ranging in the extremes from +0.08 to +0.22 inch. In Scandanavia and eastward over Russia and Siberia there has been a decided decrease, ranging from —0.02 to —0.27 inch. At isolated stations the following changes are noted: Melbourne, +0.39 inch; Ft. St. Michaels, +0.28; Hobart Town, +0.24; Ft. Napier, +0.21; Ponta Delgada and Angra, +0.15; Cape Town, +0.18; Mauritius, +0.10; Free Town, +0.06; Para-

maribo, +0.05; City of Mexico, +0.03; Honolulu, Funchal and Beirut, +0.02; Stykkisholm, —0.30; Barnaul and Gothaab, —0.24; Vladivostock, —0.20; Fao and Yeniseisk, —0.19; Pekin, —0.18; Tromso, —0.15; Tokei, —0.13; Zi-Ka-Wei, —0.11; Yokahama, —0.02. With respect to the temperature, the isotherm of 40° has entirely disappeared except at York Factory, where the mean is 38°. Stations reporting a change of 1° or less are as follows: Paramaribo and the City of Mexico, 0°; Bridgetown, Fort de France, Kingston Jamaica, San Jose de Costa Rica, Cape Town and Honolulu, 1°. Compared with *June*, 1878, the pressure is generally higher over North America, except in the Canadian Maritime Provinces. Over Europe the same can be said, but with more emphasis, the isobars of 30.00 and 30.10 occupying nearly the same positions as those of 29.90 and 30.00 respectively. But over Scandanavia and eastward into Russia and Siberia the reverse takes place, it being alike the region of lowest pressure in each year, over which the isobar of 29.70 replaces that of 29.80. Over the Japan Islands and at Zi-Ka-Wei the pressure is a little higher, while northward along the Asiatic coast it is below. At isolated stations the following changes are noted: Melbourne, +0.34 inch; Hobart Town, +0.21; Ft. St. Michaels, +0.13; Ft. Napier, +0.11 inch; Mauritius, +0.08; Cape Town and the City of Mexico, +0.06; Kingston Jamaica, and Paramaribo, +0.03; Fort de France, 0.00; Stykkisholm, —0,12; Gothaab, —0.11; San Juan de Puerta Rico, —0.07; Bridgetown, —0.06. Over India the changes are small, the pressure being higher while the reverse applies to the temperature. The temperature is generally higher over southern Europe, but considerably lower over northern Scandanavia and Russia, with slight changes over the British Isles. In the United States it is lower over the northern and southern portions, but remains about stationary in the central. At isolated stations the following changes occur: Yeniseisk, +10°; Ft. St. Michaels +8°; Barnaul, +6°; Vladivostock, Tokei and Yokohama +4°; Cape Town and Pekin, +3°; Melbourne, +2°; Hobart Town and Gothaab, +1°; Mauritius, Zi-Ka-Wei, Nassau and San Juan de Puerto Rico, no change; York Factory, —15°; Archangel and Nikolaievsk, on the Amoor, —9°; Nukuss, —6°; Stykkisholm, —5°; Free Town and Kingston Jamaica, —2°; Beirut, Tiflis, Tashkend, Ft. Napier, Paramaribo, Bridgetown, Fort de France, Navassa, Havana and the City of Mexico, —1°.

Chart No. VI.—Upon this chart are traced the paths of 22 of the principal storm areas of the northern hemisphere, during the month of June, 1879. Of these, 10 appear to have originated within the boundaries of North America and generally within the latitudes of 40° and 55° N.; four of these storms reached the Atlantic beyond Newfoundland, while two crossed the ocean to near the mainland of northern Europe. Seven storms are located over Europe; three of these came from the ocean, two in the vicinity of latitude 60° N., and one from near latitude 40° N., longitude 50° W.; of the remainder one formed over the British Isles, one in central Spain and two in northern Russia. Three storms are located over eastern Asia, and one over the Japan Isles. One storm was confined almost entirely to the Atlantic, passing over the eastern portion of the British Isles. Of the storms off North America, No. I, a continuation of low area No. XXX of *May*, 1879, appeared on the 1st, in the Ohio valley and passing thence northeastward over the Lower Lakes, changed its course to the eastward north of Kingston Can., after which it passed off the Atlantic coast and disappeared south of Newfoundland on the 3d in the high pressure area then prevailing to the eastward of that island. No. IV first appeared on the 3d in Manitoba, and moving thence southeastward crossed Lake Superior, changing its course to the east until near longitude 75° when, on the 5th, it turned slightly to the northeast and then again to the east, crossing the Gulf of St. Lawrence and leaving the Atlantic coast near the Straits of Belle Isle. Very high winds, ranging from 55 to 66 miles, accompanied the progress of this storm near the mouth of the St. Lawrence and several vessels were wrecked. No. V first appeared on the 3d on the South Pacific coast. During that day and the following it moved northward into Oregon; from the 5th to the 7th northeastward across Idaho and Montana, disappearing on the 8th to the northward of Manitoba. During the progress of this storm the highest wind velocities of the month occurred at stations in Utah and Nevada, and high northwest winds with considerable damage to shipping was reported from the Pacific coast near San Francisco. No. VII probably formed as a secondary depression to No. VI during the presence of the latter in western Wyoming. On the 7th this area passed southeastward across Wyoming, and on the 8th and 9th northeastward from Colorado to Lake Superior. During its passage over western Kansas and Nebraska terrific storms of wind, hail and rain were experienced. In several instances small towns were almost entirely destroyed and the loss in agricultural sections was immense. On the 10th the storm area was central over Lake Superior, and on the 11th crossed Canada, reaching the Gulf of St. Lawrence by the 12th. During this day and the following it passed southeastward over Cape Breton Island to the ocean. On the 13th, in 35° 30′ N. 57° W. ship *Hale* reported squall from SW. with hurricane force continuing for four hours and accompanied with blinding rain. In 28° 31′ N. 66° 57′ W. ship *Russell* reported violent SE. squall with heavy rain, vessel on beam's end. On the 14th the centre of lowest pressure was situated to the south of Newfoundland, barometer at Sydney, Cape Breton Island, 29.45, wind NW., clear; at St. John's, Newfoundland, barometer 29.47, wind SE., light rain. In 38° 30′ N. 56° 30′ W. barometer 29.57, wind W., light rain. On the 15th storm passed northeastward to near latitude 50°, barometer at St. Johns, Newfoundland, 29.49, wind

SW., fair. The winds over the Maritime Provinces changed to west and southwest with rising barometer and clearing weather. In 43° 29′ N. 57° 40′ W., ship *Nevada* reported strong westerly gale, cloudy, heavy west sea. In 46° 41′ N. 38° 24′ W., ship *Western* reported strong southwesterly gale, heavy head sea. On the 16th, passed northward of latitude 50° where it disappeared in a high pressure area extending southward from Greenland. No. VIII appeared to have formed on the 9th over the ocean to the eastward of British Columbia. On the 10th lowest pressure central in Idaho. During the 11th, 12th and 13th, passed from Colorado northeastward to Minnesota, and by midnight of the 15th had reached the Atlantic coast south of Connecticut. On the 16th, passed eastward over the ocean to longitude 60° accompanied by northwest to southwest winds and heavy rains,. In 39° N. 71° W., barometer 29.47, wind W.; in 41° N. 64° W., barometer 29.60, wind SW., heavy rain; in 42° 30′ N. 66° 30′ W., barometer 29.49, wind SE.; in 42° 16′ N. 63° 30′ W. heavy SW. squall, thick fog. On the 17th centre of lowest pressure moved northeastward to about 45° N. 46° W. In 42° N. 48° W., barometer 29.65, wind SW. heavy rain; in 40° 30′ N. 53° W., 29.77, SW. heavy rain; in 49° 36′ N. 41° 04′ W. heavy southwesterly gale. During 18th and 19th centre of lowest pressure moved northeastward to about 55° N. 20° W.; 18th, in 48° 41′ N. 32° 22′ W., SW. to NW. fresh gale, high westerly sea; in 50° 30′ N. 28° 09′ W., WSW. moderate gales, hard squalls and heavy seas. 19th, in 47° 18′ N. 37° 14′ W., WNW. strong, heavy squalls; in 48° 05′ N. 27° 23′ W., westerly gales, high head sea; in 48° 49′ N., 33° 10′ W., NW. gales, heavy rains and lightning; in 48° 30′ N. 13° W., barometer 29.36, wind SW., fair; throughout the western portion of the British Isles rapidly falling pressure and southwest to southeast winds increasing to gales with rain on the Irish coast prevailed. On the 20th centre of lowest pressure to the southwest of Iceland, barometer at Stykkisholm 29.26, wind SE., light rain. In 50° 03′ N. 22° 59′ W., wind NW. decreasing, cloudy, rainy, high northwesterly sea. Over Scotland and to the northward, south to southeast winds and slowly falling pressure prevailed, while to the southward, over England and Ireland, west to southwest winds and rising pressure obtained. On the 21st centre of lowest pressure to the northward of Iceland, barometer at Stykkisholm 29.30, wind SE., rain; at Godthaab, Greenland, barometer 29.30, calm, fair. Over the islands to the north of Scotland winds still remained southeast, but with slowly rising pressure. This storm gradually gave away to the northward as low area No. XVI formed to the south of Iceland on the 21st. No. XVII appeared to form over British Columbia on or about the 20th, and passed thence southeastward into Wyoming Territory, and, after pursuing an irregular northeasterly course over the Upper Missouri valley left the United States near longitude 90° W. On the 25th this depression began gradually to fill up over Hudsons Bay. York Factory, B. A. reported as follows :— 23rd, 29.78, 52° W.; 24th, 29.75, 56° SW; 25th, 29.83, 60° NNW.; on this date, along the northern boundary of the United States between longitude 80° and 100° W., the winds changed to SW. and W. with rapidly rising barometer. No. XIX, this depression, central in Colorado on the 23d, passed, during that day and following, northeastward over the Upper Mississippi valley to the Lake Superior region. On the 25th, after filling up considerably, it combined with low area No. XVII then over Hudsons Bay. No. XXI, on the 25th the barometer commenced falling over the Northern Rocky Mountain Slope, while to the southeast and northeast (separated therefrom by the isobar of 30.00) two areas of low pressure (surrounded each by isobars of 29.80) prevailed. On the 26th these two areas combined, forming a trough of low pressure extending southwestward from Hudsons Bay to Texas, lowest barometers as follows:—Dodge City, 29.53; Concho, Tex., 29.64; Marquette, 29.67; Pembina, Dak., 29.69. On the 27th, depression over the Northern Rocky Mountain Slope gradually filled up; trough of low pressure again divided assuming about the proportions and position maintained by the two areas on the 25th; isobars of 29.80 still unchanged. On the 28th, depression to the southward over Texas rapidly filled up; low area to the north fell rapidly at its centre with the isobar of 29.80 inclosing more than double the previous extent of territory; centre of lowest pressure over the Province of Quebec. 29th, centre of lowest pressure over the Gulf of St. Lawrence, inclosed by the isobar of 29.60; isobar of 29.80 extended southeastward to Georgia and east from longitude 83° W. to the Atlantic. 30th, area filled up slightly and moving northeastward over the ocean, gradually combined with a depression then prevailing to the southwest of Iceland. No. XXII appeared on the Middle Pacific coast on the 28th, and moved thence rapidly northeastward over the Plateau regions, reaching Manitoba by the 30th, barometer at Ft. Garry 29.49, wind S. No. XV, on the 17th the pressure began falling over the ocean to the west of Alaska peninsula, barometer at Sitka 29.87, wind S., strong, heavy rain; at Ft. St. Michaels, 29.95, N., fair. 18th, centre of lowest pressure in about 55° N. 120° W., barometer at Sitka, 30.05, wind SW. fresh, light rain; at Ft. St. Michaels, 30.03, SW., fair. 19th, centre of lowest pressure in about 55° N. 110° W., with the barometer slowly falling at York Factory and over the Saskatchewan valley, and rain, with southerly winds, to the southward near the boundary of the United States. 20th, lowest pressure over Manitoba; Ft. Garry, barometer 29.60, SW.; Pembina, 29.58, SW.; York Factory, 29.98, SE. From the 21st to 23d, depression moved eastward to the south of Hudsons Bay and thence northeastward off the Labrador coast, accompanied by no changes of importance so far as indicated upon the daily charts. During the 24th and 25th, centre of lowest pressure transferred southeastward over the ocean to about 50° N. 30° W. 25th, in 49° 09′ N. 26° 08′ W., variable winds, very heavy sea; in 47° 49′ N. 35° 57′ W., NW. fresh

gale, hard squalls; in 49° 45′ N. 27° 32′ W., barometer 29.56, NW. moderate gales; in 48° 41′ N. 31° 15′ W., W. to WNW. moderate to fresh gales, heavy head sea; in 51° 30′ N. 23° 30′ W., barometer 29.35, SSW., fair. From the 26th to 30th area of lowest pressure passed in an irregular northeasterly course between the British Isles and Iceland, where, on the latter date, it began gradually to fill up, although the area of low was still quite well marked. In connection with the passage of this storm during the last four days the lowest barometers of the month were recorded. 26th, in 53° 45′ N. 20° 30′ W., barometer 29.13, SW. strong; in 48° 35′ N. 33° 45′ W., 29.34, NNW. strong; in 45° 29′ N. 39° 29′ W., NW. strong gale, high seas; in 46° 19′ N. 39° 46′ NW. fresh gale, hard squalls all day; in 48° 38′ N. 33° 57′ W., NW. to NE., moderate gales; in 46° 44′ N. 37° 44′ W., first part of day rainy with moderate gales; during afternoon strong gales, high NW. sea; over the British Isles the barometer ranged from 29.34 to 29.86, lowest at Galway, with occasional light rains and fresh to brisk winds changing from west to southwest and southeast. 27th, in 54° 30′ N. 18° W., barometer 28.66, NW. brisk, fair; in 51° 22′ N. 14° 39′ W., SW., fresh gale, high confused sea; in 44° 43′ N. 43° 54′ W., N. hard gale, high north sea; over the British Isles barometer ranged from 29.22 to 29.94, lowest at Galway, with occasional light rains and southwest to southeast winds increasing to gales along the Irish coast. 28th, in 55° 17′ N. 14° 35′ W., barometer 29.18, strong SW. gale, high sea and threatening weather; in 51° 16′ N. 14° 02′ W., NW. fresh gale, high seas; in 50° 55′ N. 20° 32′ W., WNW. fresh gale, high head sea; Stykkisholm, 29.15, NE. brisk; over the British Isles barometer ranged from 29.32 to 29.98, (lowest at Sandwich Manse and Nairn,) with west to south winds and occasional light rains. 29th, in 54° 45′ N. 19° 52′ W. strong westerly gale, heavy sea, threatening weather; Stykkisholm, barometer 29.23, NE. gale, fair; Thorshavn, 29.43, SW. light, fair; over the northern portion of the British Isles barometer rose rapidly with west to south winds and clearing weather. 30th, Stykkisholm, 29.32, NE. gale, fair; Thorshavn, 29.63, SSE. light, fair. Concerning the storms located over Europe or reaching the mainland from the ocean, descriptions of their courses are given as follows:—No. II developed on the 1st over the British Isles as a secondary depression in connection with the passage of the area No. XXVII of the *May*, 1879, chart published in the *April*, 1881, REVIEW. During the 1st, 2d and 3d the storm centre remained about stationary over the British Isles and North sea, except a disposition on the 2d to move to the northwest beyond the former, caused by a rapid elongation of the low area, reaching from the coast of Norway southwestward to near latitude 40° N. But on the 3d, this movement was checked by a division of the trough of low pressure near latitude 50° N. followed by a decided transfer of the northern centre of the depression to the northeastward. On the dates above given occasional light rains fell over the British Isles, extending southward into France, accompanied by fresh to brisk southwest winds veering to north and northwest by the 3d. The barometric gradient was unimportant. On the 4th, centre of lowest pressure in southern Norway, barometer at Bergen 29.39; Christiana, 29.32, NE., light rain; Brono, 29.53, NE., light rain; Stockholm, 29.38, SSE., light rain. All stations in Sweden reported rain except Haparanda. 5th, lowest pressure near Gulf of Bothnia; Upsala, 29.55, S., light rain; Hernosand and Stockholm, 29.58, S., light rain. 6th, storm passed southeastward over Finland; St. Petersburg, 29.45, NNW., light rain; Kasan, 29.45, WSW., fair; Moscow, 29.52, SE. The pressure over Scandanavia rose rapidly with southwest to northwest and northeast winds. 7th, depression moved east southeast to near longitude 50° E; Krotkowo, 29.52, NW.; Kasan, 29.39, WNW.; Ekaterinburg, 29.52, ESE, light rain. 8th, course directly east; Ekaterinburg, 29.18, NE., light rain. 9th, moved northeastward and crossing the Obi river near latitude 60° N; Ekaterinburg, 29.48, NNW. 10th, moved east northeast to near longitude 80° E.; Yeniseisk, 29.42, SSE., thunderstorm; on this date and the following the depression gradually filled up over western Siberia. No. IX, developed over the ocean on the 11th, first appearing in about 42° N. 46° W.; on this date the pressure was generally below 29.90 over the ocean from latitude 35° to 50° and from the British Isles westward to longitude 50°. In 40° N. 42° W., barometer 29.68, W. brisk; in 46° 22′ N. 47° 44′ W., a. m., moderate W. gale, fog; noon, strong N. breeze; 4 p. m., NW. strong gale. 12th, in 41° 30′ N. 37° 45′ W., 29.44, SW. strong; in 49° 15′ N. 38° 45′ W., 29.44, NE. strong gale, heavy rain. 13th, in 48° 30′ N. 36° 30′ W., 29.48, N. fair; in 45° 30′ N. 44° 25′ W., 29.78, NNW. threatening; in 42° 30′ N. 33° 30′ W., 29.51, WSW. strong, fair. 14th, 15th, centre of lowest pressure moved northeastward to near the Irish coast. 16th, isobar of 29.60 covered lower half of British Isles, the North Sea and extended southward to the continent; lowest pressures over England; at Oxford and Saint Ann's Head barometer 29.47; at Greenwich, Cardington, Kew Observatory and Oscatt, barometer 29.48; rain was reported quite frequently from southern stations. 17th, depression moved eastward over the North Sea; rain quite general over the British Isles extending thence to southern Norway. 18th, centre of depression in southern Scandanavia; at Christiania, barometer 29.46, E., light rain; Bergen, 29.54, calm; Vestervig, 29.34, NE., fair; Fanoe, 29.45, W. light rain. During the 19th and 20th the depression filled up quite rapidly over northern Scandanavia and Lapland by the descent of cold air from the Arctic regions consequent upon the formation of an area of decidedly low pressure to the southwestward over Iceland. This sudden change of atmospheric conditions did not altogether interrupt the eastward movement of the low area, as on the 21st, it again appeared to the southeast of the White Sea. At Archangel, barometer 29.52, SE. fair; St. Petersburg, 29.63,

NW., fair. 22d, moved eastward to near longitude 70° E.; Archangel, 29.41, W., light rain; Ekaterinburg, 29.39, WSW., thunderstorm. 23d, moved south southeast down the valley of the Obi where further evidence of its course could not be found on our charts. No. X, after the passage of low area No. II to the eastward on the 10th, the barometer began again to fall in southeastern Russia, where, on the 11th, a new depression developed; at Kasan, barometer 29.30, W. 12th, storm centre moved eastward into Siberia; at Ekaterinburg, barometer 29.34, calm. 13th, depression gradually lost its identity as low area No. XII formed to the northwestward. No. XII, an outgrowth of the prevailing low pressure over Russia, appeared to take its initiatory form on the 13th, a little to the southeast of Finland. Moscow, 29.50, SSW., thunderstorm; St. Petersburg, 29.52, NW., light rain; Krotkowo, 29.62, S. thunderstorm; Kasan, 29.49, calm, light rain; Archangel, 29.48, NW., cloudy. 14th, depression moved to the southeast near longitude 50° E.; Kasan, 29.13, S., cloudy; Krotkowo, 29.31, W., cloudy; Ekaterinburg, 29.45, SSW., cloudy; 15th, moved east northeast beyond longitude 60° E. latitude 60° N.; Ekaterinburg, 29.17, SW., fair; Kasan, 29.18, W., cloudy; Krotkowo, 29.47, W., cloudy. 16th, again to the east and southeast; Ekaterinburg, 29.21, WSW., light rain; Kasan, 29.57, WNW., cloudy. 17th, moved to the south southeast up the valley of the Obi disappearing on the following day over southern Siberia; Ekaterinburg, 29.28, W., cloudy; Barnaul, 29.48, SE., cloudy. No. XIII.—On the 15th a decided fall in pressure occurred over central and northern Spain, probably superinduced by the passage to the northeastward, near latitude 50° N., of low area No. IX. 16th, lowest pressure passed eastward to the Mediterranean; lowest barometers at Barcelona and Murcia. 17th, lowest pressure over Northern Italy; lowest barometers at Pesaro and Moncalieri. On this and the following day the depression lost its identity with low area No. IX then prevailing to the northward over Germany and Scandanavia. No. XVI.—On the 20th an extensive area of low pressure prevailed over the ocean to the northwest of the British Isles in connection with the passage of area No. VIII. On the 21st this area divided near latitude 60° N., the southeastern portion confined within the isobar of 29.40 formed along the western coast of the British Isles, on which day northeast to southeast and southwest winds, with occasional rains, prevailed over the Islands; lowest barometer 29.35 at Armagh. 22d, depression moved northeastward over Scotland to near Norway, the circulation of the winds and the relative pressure of adjoining stations showed the centre to be over the North Sea near latitude 60°. At North Unst, barometer 29.47, E.; Aberdeen and Sandwick Manse, 29.51, NW.; Bergen, 29.51, W., light rain; Christiana, 29.62, SE., light rain; Vestervig, 29.57, S., light rain. 23d, centre of depression passed northeastward to the Gulf of Bothnia; Christiana, 29.37, SSW., thunder-storm; Haparanda and Brono, 29.38, N., fair; Hernosand, 29.34, NNE., light rain; Umea, 29.35, S., cloudy; Upsala, 29.41, NW., cloudy; Stockholm, 29.46; SW., cloudy. 24th, moved east and northeast to the White Sea; Haparanda, 29.41, NE., cloudy; Umea, 29.47, E., fair; Stockholm, 29.45., W., cloudy; St. Petersburg, 29.51, W., fair; Archangel, 29.49, S., fair. 25th, depression filled up by the descent of inflowing air consequent upon the appearance of low area No. XVI over Norway. No. XVI.—This area developed over the ocean to the southeast of Greenland on the 22d, owing its existence to the presence of low pressures to the northward of latitude 50° N., which had continued since the 17th. During this interval of five days no less than three distinct depressions had passed over or nearly over, this region. 23d, centre of lowest pressure passed east southeast to near the British Isles, along the coast of which, the barometer began to fall rapidly, with winds changing to south and southeast; lowest barometer at Galway, 29.44; in 51° 20′ N. 14° 35′ W., 29.42, SSW; in 48° 45′ N. 18° W., 29.74, W.; in 49° 15′ N. 50° 20′ W., 29.82, NW.; 24th, centre of lowest pressure over Scotland; Ardrossan, 29.45, SW., light rain; Glasgow, 29.47, W., light rain; Nairn, 29.48, calm, cloudy. 25th, centre of depression over Norway; Bergen, 29.43, SSW., light rain; Christiana, 29.40, SSW., light rain; Brono, 29.47, E., cloudy. 26th, transferred southeast beyond the Gulf of Finland; Kieff, 29.47, S., cloudy; Wilna. 29.49, NW., light rain; Dorpat, 29.50, N., thunder-storm; St. Petersburg, 29.52, E., cloudy. 27th, moved northeastward beyond latitude 60° N.; St. Petersburg, 29.13, NNW., light rain; Archangel, 29.31, ENE., heavy rain; Moscow, 29.27, S., light rain. 28th, passed eastward of the White Sea; Archangel, 29.19, E. 29th, disappeared over northern Russia. No. III.—This area throughout its course was confined almost entirely to the Atlantic Ocean, and therefore hardly belongs to the European storms. Central on the 3d, in about 40° N. 26° W., it moved slowly northeastward reaching the southern coast of Ireland on the 7th. On the 5th, in 48° 45′ N. 17° 15′ W., 29.50, NE., heavy rain; area of lowest pressure extended southeastward to northern Spain; Santiago, 29.64, SW., strong gale, light rain. 6th, in 48° 30′ N. 17° W., 29.46, E., heavy rain; in 51° 20′ N. 16° 30′ W., 29.58, NE., strong gale, cloudy; in 52° 15′ N. 16° 20′ W., 29.79, NE., strong gale; in 45° N. 28° 15′ W., NW., brisk; in 46° N. 29° 15′ W., NW., brisk; in 48° N. 15° W., SW., fresh; Santiago, 29.80, SSW., light rain. 7th, in 49° N. 15° W., 29.50, NW., strong gale, light rain; in 52° N. 23° 45′ W., 29.95, N., strong gale; Santiago, 29.65, SSW., light rain; Valencia, 29.44, SSE., misty; Roche's Point, 29.50 SE., light rain; Galway, 29.45, ESE., cloudy. 8th, area of lowest pressure covered the British Isles, accompanied by generally rainy or threatening weather; Falmouth, 29.44, SSE.; Valencia, 29.44, NW.; Armagh, 29.47; Roche's Point, 29.46, ESE. 9th, depression moved slightly to the north with a tendency to leave the western coast of Scotland; the pressure rose generally at all land stations, with winds shifting to east and northeast, but rain or threatening

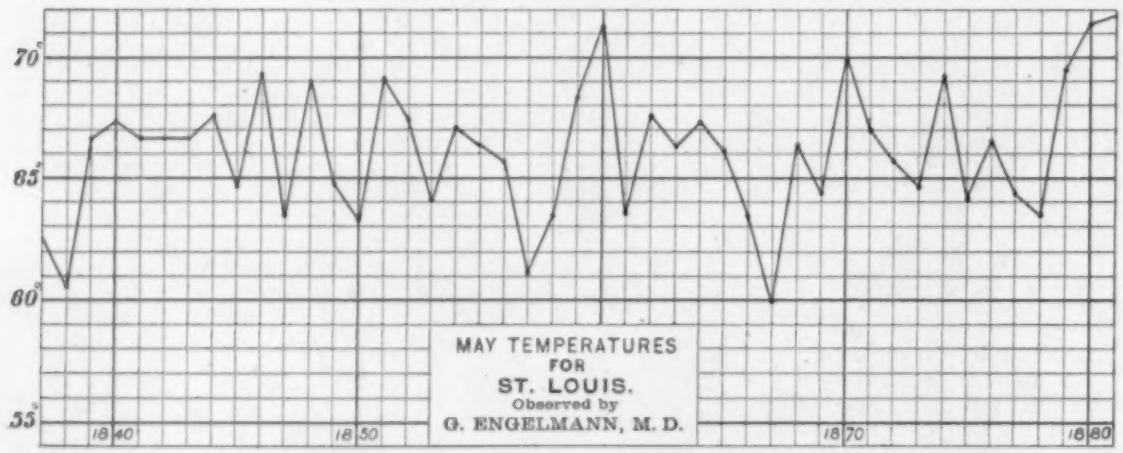
weather still prevailed. 10th, disappeared to the northwest in an area of high pressure then prevailing over Iceland and to the southward. The following descriptions relate to the storms of Eastern Asia and the Pacific Ocean: No. VI.—On the 3d and 4th the barometer fell to the southwest of the Japan Isles, forming a slight depression which, on the 5th, passed over them to the northeast, with winds changing from northeast to southeast and southwest. Occasional light rains accompanied the depression on the first two days. On the 6th the centre passed eastward over the ocean. No. XI.—For some three days previous to the formation of a well defined area of depression the pressure over northern China had shown considerable variability. On the 11th, centre of depression lay to the northwest of Pekin, barometer at that station 29.39, SW., fair; the pressure to the southeast, at Shanghai and at other stations along the coasts of the Yellow and Japan seas, was below 29.60, with occasional rains. 12th, central over the Japan Sea; winds over the Japan Isles from southeast to southwest and to the northward, along the coast of Corea, from northeast to northwest; in 38° N. 150° E., barometer, 29.45, E., strong gale, heavy rain. 13th, passed eastward to about longitude 150° E. and thence northeastward over the North Pacific Ocean to the Aleutian Islands, whence the course again changed to east. On the 16th, reached the Alaska Peninsula, disappearing thereafter in an area of high pressure prevailing along the Pacific coast of North America. No. XIV.—On the 16th and 17th the pressure fell over southern China and particularly along the coast, where southeast to southwest winds and light rains prevailed. 18th, lowest pressure passed northeastward to the Yellow Sea; in 37° 30′ N. 122° 12′ E., barometer, 29.47, NNW., strong gale, light rain; Shanghai, 29.72, SW., fresh, cloudy; Nagasaki, 29.82, SW., brisk, cloudy; Pekin, 29.71, NW., fresh, light rain. 19th, depression passed east northeast over the northern portion of the Japan Islands, followed by rapidly rising pressure and winds shifting to west and southwest; rain still continued at Japanese stations and commenced along the northern coast of the Japan Sea. 20th, depression disappeared over the ocean. No. XX.—This area was probably a continuation of low area No. X from the European coast, but because of the entire absence of data over eastern Siberia it was not thought advisable to unite the two. On the 25th and 26th depression passed eastward to the south of the Kamtchatka Peninsula and thence northeastward over Kamtchatka Sea, reaching Alaska by the 28th. The barometer at Ft. St. Michaels fell steadily from the 26th, reaching its minimum on the 28th, 29.48, S, light rain. The winds at Unalaska shifted from northwest to southeast and southwest, accompanied on the 28th and 29th by light rains and rising temperature. 29th and 30th, depression disappeared to the eastward over British America, probably uniting with low area No. XXV, then central over the Saskatchewan Valley; a further description of this storm will probably appear in the JUNE REVIEW. Compared with June, 1878, Chart No. VI presents several points of resemblance as well as of contrast. Within the United States the storm tracks are confined to higher latitudes, none reaching to any extent south of parallel 40°. Over the Atlantic Ocean the same peculiarity is observed, added to which is the fact that the storm paths to the east of Greenland have pursued very much the same course, passing north northeastward between that country and Iceland, or skirting the eastern border of the latter. No storm, so far as our data can be depended upon, actually reached the mainland of Europe from America, while in June, 1878, two passed over the ocean in a distinct manner, and to a considerable distance inland. In western British America there is presented a striking similarity in the movement of a single area for each month, coming, as it did in each instance, from the neighborhood of Alaska and passing thence southeastward into the United States, the paths of each being almost identical. The peculiarity of the disappearance of storm areas over, or in the vicinity of Hudson's Bay, presents a noticeable resemblance for the two years. Three disappeared in June, 1878, and four in June, 1879. Over northwestern Siberia and in northern Russia the presence of storm areas was a marked feature of the month in June, 1879, while hardly one appeared over this territory in June, 1878. This contrast may appear more intelligible when we recall under the description of Chart No. V (this REVIEW) the comparatively higher pressures over this region in the latter year.

TEMPERATURE OF THE AIR.

The mean temperature of the air for May, 1881, is shown by the isothermal lines (in red) on Chart No. II. The table of mean and comparative temperatures in the right-hand corner of the chart shows, in the first column, the average for the month throughout the various districts, as deduced principally from observations taken at Signal Service stations. In the two remaining columns are shown the means for the present month, and the departures of such means from the average for many years. With the exception of the Rio Grande valley, the Southeast Rocky Mountain Slope and the Florida Peninsula, the temperature is everywhere above the normal, ranging from +0°.6 in New England to +6°.2 in the Upper Mississippi valley. The greatest departures are confined to the northern portions of the country east of the 100th meridian. A normal condition is reported from the Florida Peninsula, and only a change of —0°.5 from the Southeast Rocky Mountain Slope.

Deviations from Mean Temperatures.—Under this heading departures exhibited by the reports from the regular Signal Service stations are shown in the table of comparative temperatures on

the right hand side of chart No. II. The following items of importance in connection with this subject are reported by voluntary observers: *Illinois*: Riley, mean temperature 0°.3 below that of past 20 years. *Iowa*: Clinton, month remarkable for high temperatures, the mean being above the average for several years. *Kansas*: Lawrence, mean temperature 3°.6 above that of past 13 years. Wellington, mean temperature 1°.9 above the normal; daily record of temperature remarkable for its uniformity, no extreme or sudden movements being observed; the minimum night temperature has averaged 15° higher than for the corresponding months of 1879 and 1880; the small range of temperature for the month (36°) taken in connection with sufficient moisture in the soil, the temperature being constantly at the germination point for vegetation, resulted in a vigorous growth of the same, which has greatly exceeded any previous record or the memory of the oldest inhabitants of this locality. *Maine:* Gardiner, mean temperature 0°.3 below that of past 45 years. *Maryland:* Fallston, mean temperature 2°.1 above that of past 10 years. *Missouri:* St. Louis, "Missouri Weather Service" reports mean temperature 5° above that of the past 45 years; during that period the highest means were reported as follows: 71°.3 in 1880 and 1860 and



70°.0 in 1870; the coldest May occurred in 1867, mean 60°.0. The above diagram shows the curve of mean temperatures for May, as furnished by Prof. T. E. Nipher, of the "Missouri Weather Service." *Nebraska:* Lincoln, "Nebraska Weather Service" reports mean temperature 2°.9 below the average; average of all noon observations 3° colder than May 1879 and 6° colder than in 1880. *New Hampshire:* Contoocookville, mean temperature 2° above that of past 10 years. *New Jersey:* Newark, mean temperature 2°.2 above that of past 35 years; highest maximum 96° occurred in 1880, lowest minimum 30° occurred in 1861; ground thermometers rose as follows: 18 inch from 50° to 62°, 36 inch from 48° to 56°; mean temperature of spring 47°.43 or 0°.81 below the average of past 35 years. *New York:* Waterburg, mean temperature 6°.1 above that of past 10 years. North Volney, mean temperature 4°.1 above that of past 13 years; highest mean during that period occurred in 1880, 62°.7, lowest in 1869, 52°.4. Palermo, mean temperature 4°.1 above that of past 28 years. *Ohio:* Cleveland, mean temperature 4°.7 above that of past 27 years; highest mean 65°.8 occurred in 1880, lowest 52°.4 occurred in 1867. *Pennsylvania:* Dyberry, mean temperature above the average for many years. *Virginia:* Wytheville, mean temperature 3° above that of past 17 years; maximum temperature for the month (90°) has been reached but 3 times in past 17 years. *West Virginia:* Flemington, month unusually warm.

Ranges of Temperature at Signal Service Stations—*Monthly ranges* in general varied from 35° to 50° over the country east of the Rocky Mountains, and from 40° to 55° to the westward of that region. Ranges less than 45° occurred in the following districts: California, Southeast Rocky Mountain Slope, Rio Grande Valley, Gulf States, Tennessee, South Atlantic States, and at scattering stations in the Middle Atlantic States, New England, Upper Lake region, Missouri valley, and Northern Pacific Coast region. The *smallest ranges* were: Key West and San Diego, 22°; Port Eads and Punta Rassa, 24°; Cedar Keys and Galveston, 25°; San Francisco and Little Rock, 26°; Brownsville, Indianola and Pensacola, 29°; Shreveport, New Orleans, and Augusta, 30°. The *largest* were: Ft. Keogh, 64°; Fts. Shaw and Marquette, 63°; Ft. Buford, 62°; Ft. Lapwai, 61°; Ft. Assiniboine, 60°. The *daily ranges* varied in the different districts as follows: New England, from 21° on the summit of Mt. Washington and 22° at Wood's Holl to 35° at Portland, New London, and New Haven, and 43° at Boston; Middle Atlantic States, 18° at Cape May and 21° at Delaware Breakwater to 31° at Washington and Philadelphia and 33° at New York; South Atlantic States, 22° at Kittyhawk, Savannah, and Cedar Keys, and 27° at Smithville and Charlotte to 29° at Augusta; Eastern Gulf States, 15° at Key West and 20° at Punta Passa to 27° at Mobile

and 29° at Montgomery; Western Gulf States, 18° at Port Eads and 20° at Little Rock and Galveston to 28° at Corsicana, Fredericksburg and San Antonio and 30° at Mason; Rio Grande valley, 23° at Brownsville to 33° at Rio Grande and 36° at Eagle Pass; Ohio valley and Tennessee, 21° at Chattanooga and 24° at Cincinnati to 34° at Nashville, 36° at Morgantown and 41° at Pittsburg; Lower Lake region, 25° at Erie and 28° at Detroit to 33° at Cleveland, 34° at Oswego and 37° at Rochester; Upper Lake region, 27° at Grand Haven and 29° at Duluth to 34° at Alpena and 41° at Port Huron; Upper Mississippi valley, 19° at Cairo and 24° at Davenport and St. Louis to 30° at Springfield and 32° at Des Moines and St. Paul; Missouri valley, 27° at Omaha and 29° at Leavenworth to 31° at Yankton and 39° at Ft. Bennett; Extreme Northwest, 37° at Moorhead and 46° at St. Vincent to 53° at Ft. Stevenson and 56° at Ft. Buford; Northern Slope, 36° at Cheyenne and 38° at North Platte to 40° at Deadwood and 49° at Ft. Keogh; Middle Slope, 19° on summit of Pike's Peak and 29° at Dodge City to 32° at Fort Elliott and 36° at Denver; Southern Slope, 28° at Fts. Sill and Griffin and 34° at Concho to 42° at Stockton, 48° at El Passo and 50° at Davis; Northern Plateau, 38° at Lewiston and 39° at Boise City to 45° at Dayton, and 50° at Missoula; Middle Plateau, 33° at Pioche and Salt Lake City to 48° at Winnemucca; Southern Plateau, 25° at Shakespeare and 31° at Santa Fe to 48° at Florence and 49° at Camp Thomas and La Mesilla; North Pacific Coast, 33° at Portland to 38° at Olympia and 42° at Roseburg; Middle Pacific Coast, 23° at San Francisco to 32° at Sacramento and 35° at Red Bluff; South Pacific Coast, 19° at San Diego to 39° at Los Angeles and Yuma, 41° at Visalia and 59° at Campo.

Table of Maximum and Minimum Temperatures for May, 1881.

State or Territory.	Signal Service.			U. S. Army Post Surgeons or Voluntary Observers.		
	Station.	Max.	Min.	Station.	Max.	Min.
Alabama	Montgomery	96°	58°	Auburn and		
Do				Green Springs		56°
Arizona	Tucson	106°		Texas Hill	108°	
Do	Yuma		31°			
Arkansas	Little Rock	87°	61°	Mt. Ida	88°	
Do				Fayetteville		48°
California	Visalia	95°		Turlock	109°	
Do	Campo		31°	Summit		30°
Colorado	Denver	84°		Hermosa	92°	
Do	Pike's Peak		5°			
Connecticut	New London	89°				
Do	New Haven		36°			
Dakota	Ft. Bennett	92°	28°	Ft. Buford		22°
Do	Bismarck		28°			
Delaware	Breakwater	82°	45°	Dover	90°	
Dist. Columbia	Washington	95°	44°			
Florida	Jacksonville	96°	63°	Ft. Barrancas, St. Augustine and Houston		60°
Do						
Do						
Georgia	Augusta	98°		Forsyth	99°	
Do	Atlanta		52°	M'Pherson Bks		50°
Iowa	Dubuque	90°		Clinton	95°	35°
Do	Davenport		38°			
Idaho	Ft. Lapwai	88°	27°			
Do	Lewiston and					
Do	Boise City	88°				
Illinois	Springfield	88°	37°	Peoria and		
Do	Chicago	88°		Elmira	93°	
Indiana	Indianapolis	89°	44°	Logansport	99°	
Do				Spiceland		41°
Indian Ty	Fort Gibson	92°				
Do	Fort Sill		56°			
Kansas	Leavenworth	90°	38°	Independence	93°	
Do				Clay Centre	93°	40°
Kentucky	Louisville	93°	51°			
Louisiana	Shreveport	92°		Pt. Pleasant	93°	
Do	New Orleans		60°			
Maine	Portland	86°		Gardiner		27°
Do	Eastport		32°			
Maryland	Baltimore	95°	46°	Woodstock		38°
Massachusetts	Boston	91°	36°	Williamstown		25°
Michigan	Marquette	88°	25°	Hudson and		
Do	Port Huron	88°		Litchfield	94°	
Do				Ft. Brady		24°
Minnesota	Moorhead	88°		New Ulm	89°	
Do	St. Vincent		28°			
Mississippi	Vicksburg	94°	62°			
Missouri	St. Louis	91°	48°			
Montana	Fort Keogh	98°				
Do	Ft. Assinnib'e					
Do	& Rock Creek		20°			
Nebraska	North Platte	88°	37°	Ft. Niobrara	96°	
Nevada	Winnemucca	86°	28°	Carson City	94°	
Do				Palisade		25°
N. Hampshire	M. Washington	61°	8°	Contoocooky'e	88°	
New Jersey	Sandy Hook	91°		South Amboy	97°	
Do	Barnegat		37°	Atco		32°
New Mexico	La Mesilla	101°		Ft. Union		28°
Do	Sante Fé		33°			
New York	New York City	93°		West Point	98°	
Do	Buffalo		32°	Madison B'ks		21°
North Carolina	Charlotte	94°		Weldon	96°	
Do	Fort Macon		50°	Murphy		43°
Ohio	Columbus	92°		Cincinnati,		
Do	Cleveland		36°	Jacksonburg,		
Do				and Ruggles	96°	
Oregon	Roseburg	85°	36°	Ft. Klamath		17°
Pennsylvania	Pittsburg	95°	38°	Milton	100°	
Do				Dyberry		21°
Rhode Island	Newport	85°	39°	Ft. Adams		35°
South Carolina	Charleston	91°	56°	Aiken	97°	53°
Tennessee	Knoxville	93°	49°			
Texas	Rio Grande	102°		Ft. Ringgold	106°	
Do	Fort Davis		41°	Ft. Brown		36°
Utah	Salt Lake City	86°	40°	Promontory	91°	
Do				Kelton		30°
Vermont	Burlington	85°	30°	Charlotte	90°	
Do				Woodstock		23°
Virginia	Lynchburg	96°		Accotink	97°	
Do	Fort Myer		43°	Ft Monroe		42°
Washington Ty	Almota	87°				
Do	Colfax		25°			
West Virginia	Morgantown	85°	39°	Flemington	90°	
Wisconsin	Madison	85°	38°	Beloit	91°	31°
Do	Milwaukee	88°				
Wyoming	Cheyenne	79°	32°	Ft. Fetterman	85°	
Do				Ft. Bridger		16°

Frosts were, with few exceptions, confined to that portion of the country north of parallel 40°. To the southward of that boundary they were reported as follows: Maryland, Fallston, 1st; Glyndon, 17th, 20th. Colorado, Pike's Peak, 13th, 21st, 22d, 25th. Nevada, Carson City, 7th, 17th, 18th, 19th, 23d, 24th, 25th. Arizona, Prescott, 11th. California, San Gorgonio, 1st, 2d, 11th, 24th to 26th; Campo, 26th, 29th, 30th. In the northern portion they were reported in the various districts as follows: New England, 1st, 3d to 5th, 14th; Middle States, 1st to 5th, 7th; Lower Lake region, 1st to 4th, 17th, 18th; Upper Lake region, 2d to 4th, 7th, 15th to 17th; Upper Mississippi valley, 2d, 4th, 15th; Missouri valley, 2d, 3d, 20th; Northern Rocky Mountain slope, 1st, 2d, 12th, 18th to 20th; Northern Plateau, 1st, 2d, 7th, 8th, 10th to 12th, 14th to 19th; North Pacific coast, 1st, 11th, 16th, 17th, 21st, 24th; Umatilla, 1st, injuring vegetation; Dayton, 22d, killing vegetables.

Ice formed during the month in few localities, and invariably in the region north of parallel 40°. Strafford, Vt., 1st, 3d, 4th, 5th; Mt. Washington, 14th; Fall River, Mass., 1st; Rowe, Mass., 3d, 4th, 5th; Friendship and Flushing, N. Y., 1st; Milton, Pa., 4th; Chicago, 4th; Eagle Rock, Idaho, 7th, 18th, 19th.

PRECIPITATION.

The general distribution of rainfall (including melted snow) for May, 1881, is shown on Chart No. III, from the reports of over 500 stations. From the table in the left hand corner of the chart is obtained a monthly average for each of the various districts, determined from the records (covering a period of many years) of Signal Service stations, and also a comparison of the present month with such averages. In general there is a marked deficiency for the month, which, however, is coupled with striking irregularities in the distribution, particularly in Texas and the Missouri valley, where in several localities the heaviest precipitation ever recorded has fallen. This unusual record of rain fall was probably due, in large measure to the peculiar direction and sluggish movement of low area No. V. The largest deficiencies occurred in the South Atlantic, Eastern Gulf States and in the North Pacific Coast region, where, particularly in the two former districts, large excesses are common to the month of May. The largest excess was reported from New England, where the deviation from the normal for the month has not been exceeded in any previous year since the establishment of Signal Service stations. The deficiency in the Upper Lake region, although small, is not unusual, while over the Lower Lakes the deficiency, though larger, is considerably below the average. The deficiency in the Upper Mississippi valley is very unusual and larger than ever before recorded. In the Southern Pacific coast region the condition is normal, being the only district reporting the same. Throughout the San Joaquin and Sacramento valleys the deficiency has been considerable, but few stations reporting any rainfall at all, the largest being 0.79 inches at Red Bluff. Over the Rocky Mountain and Plateau districts there appears to be an excess at many stations, although the usual irregularity of distribution is observable. Elsewhere the changes are unimportant.

In connection herewith the following notes from voluntary observers are of interest: *Alabama:* Auburn, month unusually dry. *Florida:* Houston, month very dry; no rain; garden truck drying up. *Georgia:* Forsyth, exceedingly dry; crops seriously injured. *Illinois:* Riley, monthly rain-fall 2.02 inches above mean for past 20 years, and only exceeded twice during that time, viz.: in 1861 and 1868. *Indiana:* Vevay, monthly rain-fall 3.24 below mean for several years; crops suffering severely. Wabash, rain-fall below the average; crops suffering. *Iowa:* Ft. Madison, month very dry; wells and streams drying up. Independence, month unusually dry; crops suffering; streams very low. *Kansas:* Lawrence, monthly rain-fall 0.64 below the average, but quite evenly distributed. Clay Center, month remarkable for frequent and heavy rains. Yates Center, month characterized by unusually heavy rains. Wellington, monthly rain-fall 6.84 above mean of past 2 years; month remarkable for an excessive and general distribution of rain-fall, and likewise for the absence of violent or heavy rains with stormy gales. *Maine:* Gardiner, month very wet; monthly rain-fall 2.02 above average for past 45 years. *Michigan:* Litchfield, month very dry; crops suffering and streams low. Thornville, month very dry; crops suffering. *Missouri:* St. Louis, "Missouri Weather Service" reports a deficiency of about 0.70; larger deficiencies were reported, as follows: 1.73 in 1860, 2.79 in 1870 and 1.51 in 1880; throughout the State the precipitation has been decidedly less than in 1878, more than in 1879 and about the same as in 1880. *Nebraska:* Lincoln, "Nebraska Weather Service" reports average rain-fall for entire State at 6.65 inches, or 1.75 above the average for past 9 years, and double the rain-fall of 1880; in some parts of the State rain fell on 23 days. *New Hampshire:* Contoocookville, monthly rain-fall above the average of past 10 years. *New Jersey:* Newark, monthly rain-fall 1.25 below the mean of past 35 years; total rain-fall for spring 10.24, or 4.64 below the average for past 35 years. *New York:* Waterburg, monthly rain-fall 2.70 above average for past 9 years. North Volney, monthly rain-fall 0.22 above average for past 8 years; smallest rainfall for that period occurred in 1876; largest in 1878. Palermo, monthly rain-fall 1.10 below mean for past 22 years. *North Carolina:* Weldon, month very dry. *Ohio:* Cleveland, monthly rain-fall 2.34 below mean of past 27 years; largest precipitation during that period occurred in 1858, 7.74 inches; smallest in 1877, 0.75 inch. Ruggles, month very dry; crops suffering. *Tennessee:* Ashwood, month very wet; precipitation unusually heavy. *Texas:* Melissa, month remarkable for heavy rains; rain-fall for the month nearly the annual average; largest precipitation for the past 30 years. Clarksville, month remarkable for incessant rains. *Virginia:* Wytheville, monthly rainfall 0.93, or less than for any May in past 17 years except 1875, when it was 0.50; rain-fall for the month 2.67 below the average of the past 17 years; drought during the month very severe; crops suffering, and seed lying in the ground does not germinate. *West Virginia:* Flemington, month very dry; crops suffering, and wells and small streams drying up.

Special Heavy Rain-falls.—2d, Melissa, Tex., 3.00 inches. 3d, Mason, Tex., 2.19; Paducah, Ky., 2.19. 4th, Paducah, Ky., 2.25. 4th and 5th, Fort Davis, Tex., 2.85. 5th, Fayette, Miss, 2.00; Melissa, Tex., 4.00. 5th and 6th, Castroville, 2.22. 6th, Wellsboro' Pa., 2.10; San Antonio, 2.10; Browns-

ville, 2.07. 7th, Melissa, Tex., 2.50; Ft. Smith, Ark., 2.02. 8th, Shreveport, 2.70; Mt. Ida, Ark., 5.15. 10th, Vail, Ia., 2.37; Lincoln, Neb., 2.25; Chattanooga, 2.31; Ft. Fetterman, Wy. Ty., 3.10. 10th and 11th, Lincoln, Neb., 3.50. 14th, New Corydon, Ind., 2.01; Dodge City, 2.65. 15th and 16th, Rowe, Mass., 4.10. 16th, Ft. Randall, Dak., 2.00. 17th, Antrim, N. H., 2.80; Orono, Me., 2.76; Eastport, 5.48; Concho, Tex., 3.40; Morriston, Dak., 3.40; Yankton, 2.10. 18th, Lincoln, Neb., 2.33; Dodge City, 2.10; Omaha, 2.26; Yates Centre, Kans, 2.82; New Shoreham, 2.76. 19th, Mt. Washington, 2.80. 19th and 20th, Wellington, Kans, 3.75. 20th, Eastport, 4.17; Southington, Conn., 2.85; Yates Centre, Kans, 2.89; Melissa, Tex., 3.10. 22d, Ashwood, Tenn., 2.50; Mt. Ida, Ark., 2.15; Franklin, N. C., 2.30; Melissa, Tex., 5.00. 23d, Pierce City, Mo., 2.00. 24th, North Platte, 2.25; Melissa, Tex., 4.00; Elizabeth, N. J., 2.07. 24th and 25th, Corsicana, 6.46. 26th, Ft. Meade, Dak., 2.75. 27th, Holton, Kans., 2.25; Melissa, Tex., 4.00; Olivet, Dak., 3.61. 28th, Corsicana, 3.74; Melissa, Tex., 2.00; Ft. Hartsuff, Neb., 2.14. 30th, Elsworth, N. C., 2.25; Melissa, Tex., 2.50.

Largest Monthly Rainfalls.—Melissa. Tex., 34.85 inches; Corsicana, 14.33; Eastport, 13.22; Mt. Washington, 12.50; Lincoln, Neb., 11.89; Mt. Ida, Ark., and Paducah, Ky., 10.15; Olivet. Dak., 10.08; Yankton, 9.88; Wellington, Kans., 9.37; Ashwood, Tenn., and Logan, Ia., 9.30; Yates Centre, Kans., 9,09; Shreveport, 8.63; Ft. Hartsuff, Neb., 8.42; Eagle Pass, 8.16; De Soto Neb., 8.09; Denison, 8.03; Omaha, 7.94; Escanaba, 7.91; Laredo, 7.75; Morrison, Dak., 7.40; Rowe, Mass., 7.25; Thatcher's Island, 7.22; Creswell, Kans., 7.16; Ft. Gibson, 6.96; Genoa, Neb., 6.85; Ft. Smith, Ark., 6.84; Concho, 6.82; Pierce City, Mo., 6.70; Manhattan, Kans., 6.67; Independence, Kans., 6.61; Uvalde, 6.44; Ft. Snelling, Minn., 6.39; Ft. Davis, 6.31; Fredericksburg, 6.30; Howard, Neb., 6.28; Antrim, N. H., 6.15; Ft. Randall, Dak., 6.05; Ft. Sill, 6.04; Clay Centre, Kans., 6.00.

Smallest Monthly Rainfalls.—Ft. Yuma, Salinas City, Lathrop, Stockton, Brighton, Rocklin, Alta, Byron, Davis, Niles, Pleasanton, Livermore, Tracy, Galt, Auburn, Colfax, Cisco, Summit, Boca, Martinez, Brentwood, Woodland, Menlo Park, Gilroy, Hollister, Pajaro, Solidad, Monterey, Santa Cruz, Chico, Modesto, Turlock, Merced, Kingsbury, Goshen, Sumner, Mojave, Ravenna, Newhall, San Fernando, Los Angeles, Spadra, Colton, Indio, Mammoth Tank, Ione, Farmington, Lemoore, Anaheim, Petaluma, and Benson, Cal., Halleck, Toano, Browns and Humboldt, Nev., and Texas Hill and Maricopa, Ariz., none; Sacramento, Benicia Barracks, Colfax, Marysville, Antioch, Borden and Wilcox, Cal., trace; Kelton, Utah and Los Angeles, 0.01; Reno, Nev., 0.02; San Mateo and Poway, Cal., 0.03; Tucson and San Diego, 0.04; Alcatraz Island and Delano, Cal., 0.03; Napa and Tehachapi, Cal., and Umatilla, 0.06; Ft. Thomas, Ft. Verde, Wickenburg, Ariz., and Boise City, 0.07; Wadsworth and Tecoma, Nev., and Fresno and Suisun, Cal., 0.10; Princeton, Cal., 0.11; Tulare and Campo, Cal., Hot Springs and Terrace, Nev., and Phœnix, Ariz., 0.12; Pt. San Jose, Cal., and Florence, 0.13; Angel Island, Cal., and Carson City, Nev., 0.15; Williams, Cal., 0.17; Keene, Cal., 0.19; Dunnigan, Cal., 0.20; Pioche, 0.21; San Francisco, 0.22; Hermosa, Col., Calienta, Cal., and Lewiston, 0.23; Calistoga and Knight's Landing, Cal., 0.25; Ft. Lapwai, Idaho, and Ft. Grant, Ariz., 0.26; South Vallejo, Cal., 0.27; Ft. Apache, Ariz., and Tuohey's Ranche, Cal., 0.28; Visalia, Cal., and Missoula, Mont., 0.29; Wallace, Kans., and Oakland, Cal., 0.30; Kinneyloa, Cal., 0.32; Wells, Cal., 0.35; Ft. McDermit, Nev., and Margaretta, O., 0.36; Emigrant Gap, Cal., 0.37; Oakland, Cal., 0.30; Ft. Madison, Ia., Ft. Bridger, Wyo., and Truckee, and Tehama, Cal., 0.40; Battle Mountain and Beowawe, Nev., 0.42; Prescott, 0.44; Toledo, and Dayton, 0.45; Charleston, 0.48; Greensboro, N. C., Genesee, Ill., and Spokane, Wash. Ty., 0.50.

Cloudy Days.—The number varied in New England from 5 to 17; Middle Atlantic States, 5 to 16; South Atlantic States, 3 to 10; Eastern Gulf States, 1 to 8; Western Gulf States, 2 to 14; Ohio valley and Tennessee, 1 to 9; Lower Lake region, 4 to 11; Upper Lake region, 4 to 14; Upper Mississippi valley, 4 to 14; Missouri valley, 8 to 23; Red River of the North valley, 8 to 14; Texas, 2 to 19; Rocky Mountains, 5 to 11; Middle Plateau, 4 to 6; Southern Plateau, 0 to 9; California, 0 to 12; North Pacific Coast region, 6 to 11.

Rainy Days.—The number of days on which rain has fallen varies as follows: New England, 10 to 18; Middle Atlantic States, 7 to 17: South Atlantic States, 5 to 14; Eastern Gulf States, 3 to 11; Western Gulf States, 8 to 18; Ohio valley and Tennessee, 6 to 19; Lower Lake region, 10 to 17; Upper Lake region, 6 to 21; Upper Mississippi valley, 10 to 15; Missouri valley, 12 to 20; Red River of the North valley, 11 to 15; Texas, 7 to 21; Rocky Mountains, 12 to 24; Middle Plateau, 2 to 6; Southern Plateau, 1 to 15; California, 0 to 6; North Pacific Coast region, 2 to 13.

Rain from a Cloudless Sky.—Ft. Myer, Va., 21st, 10.10 p. m., a shower of rain, lasting five minutes, fell when the entire sky overhead seemed free from clouds, and stars could be seen shining brightly, although some light clouds were visible near the western horizon.

Snow fell, with few exceptions, over a narrow belt of country reaching from northwestern Montana, southeastward to central Colorado, and was reported from various stations on the following dates: Ft. Shaw, 22d, 23d; Helena, Deer Lodge and Ft. Benton, 22d; Fort Ellis, 13th; Deadwood, 11th; Ft. Washakee, Wyo. Ty., 12th, 18th; Cheyenne and Denver, 17th; summit of

Pike's Peak, 1st to 4th; 6th, 7th, 12th, 18th, 19th, 20th, 23d, 26th, 29th, 30th, 31st; Colorado Springs, 17th, 18th, 19th; Carson City, Nev., 22d on mountains west of station; Otego, Nev., no date; Summit and Truckee, Cal., no date; on summit of Mt. Washington, 2d, 6th.

Snow on Ground at end of Month.—Pike's Peak, 16.50 inches.

Hail-storms were of frequent occurrence in various parts of the country, the most destructive being reported as follows: Newtown, Pa., 28th, between 5 and 6 p. m., very violent, thousands of panes of glass were broken, vegetable gardens and fields of grain entirely destroyed, fruit trees stripped of blossoms and leaves, and in several cases of bark. Path of storm very narrow, in some cases being so sharply defined as to follow the highway committing damages on but one side. In some portions of the track hailstones as large as walnuts fell, covering the ground to a depth of two to three inches. Direction of storm path, southwest to northeast, length about six miles. Terrific hailstorms visited this section about the middle of May, in 1860 and 1869. Belle County, Tex., 28th, p. m., very violent, destroying crops and damaging buildings; especial injury was inflicted upon corn, cotton, and wheat. New Hackensack, N. Y., 31st, during afternoon, terrific storm, extending from this point to Fishkill Plains. All grain along the storm's path entirely destroyed and corn and young fruit killed. Storm lasted about 45 minutes. Some hailstones were two inches in diameter, and on the following morning hail was found in some places a foot deep. St. Clair, Mich., 14th, 3.30 p. m., rain fell in almost incredible quantities, and hailstones were as large as hickory nuts; a large quantity of window glass was broken and great damage done to fruit trees. Bellville, Mo., 14th, about 1 p. m., very violent; fruit trees and garden truck suffered severely; large quantities of window glass broken; much damage to farm crops. Brockway Centre, Mich., 14th, about 3 p. m., terrific storm of hail and wind, hailstones largest ever known to have fallen here, some measured 1½ inches in diameter. Hardly a house in the track of the storm but had all the glass in the north and west sides broken out. Several buildings were blown down and great damage done to grain crops and fruit trees. Length of storm path about six miles, direction from southwest to northeast. Bloomfield, N. J., 22d, hail fell in great quantities and of large size, doing terrible damage to greenhouses, tender plants and strawberries. This storm was equally severe at other points in New Jersey, viz, Paterson, Orange and Irvington. La Mesilla, 18th, half inch in diameter. Colorado Springs, 17th, 3.10 p. m., lasting 15 minutes; stones one inch in diameter. Spearville, Kans., 1st, stones size of walnuts; much property destroyed. Ft. Davis, 2d, 4th, 26th, stones as large as quails' eggs. Highland Station, Tex., 8th, doing considerable damage to crops and window glass. Corsicana, 24th, hailstones as large as hickory nuts, great damage to grow ing crops. Macon, N. C., 18th, 10.07 to 11.45 a. m., completely destroying gardens and farm crops in vicinity. Nora Springs, Ia., 30th, stones varying in size from peas to filberts.

RELATIVE HUMIDITY.

The percentage of mean relative humidity for the month ranges as follows: New England, 71 to 89; Middle Atlantic States, 58 to 90; South Atlantic States, 59 to 81; Eastern Gulf States, 59 to 81; Western Gulf States, 66 to 77; Ohio Valley and Tennessee, 55 to 69; Lower Lake region, 62 to 75; Upper Lake region, 65 to 75; Upper Mississippi valley, 57 to 69; Missouri valley, 66 to 70; Red River of the North valley, 67 to 69; Texas, 31 to 76; Middle Plateau, 26 to 34; Southern Plateau, 24 to 39; California, 39 to 75; Oregon, 44 to 57; Washington Territory, Olympia, 68. *High stations* report the following percentages not corrected for altitude: Pike's Peak, 65.4; Santa Fe, 35.8; Cheyenne, 52.8; Denver, 52.2; Mt. Washington, 82.1.

WINDS.

The prevailing winds during May, 1881, at Signal Service stations, are shown on chart No. II by arrows which fly with the wind. Along the New England and South Atlantic coasts, and from the Ohio valley southeastward to the ocean, they were from the *northeast;* along the Middle Atlantic coast, from *southeast* to *southwest;* throughout the Mississippi valley and in Texas, *southeast* and *south;* in the Lake region, *variable;* in the Rocky Mountain region, *southerly;* over the Middle and Northern Plateaux and Northern Pacific coast region, *north* to *west.*

Total Movements of the Air.—The following are the largest total movements at Signal Service stations: Mt. Washington, 20,133; North Platte, 11,418; Pikes Peak, 11,269; Portsmouth, N. C., 10.870; Dodge City, 10,576; Hatteras, 10,526; Kittyhawk, 10,430; Chincoteague, 10,318; Delaware Breakwater, 9,665; Ft. Elliott, 9,206; Thatcher's Island, 9,196; New Shoreham, 9,007; San Francisco, 8,776; Cape Henry, 8,763; Bismarck and Stockton, 8,662; Moorhead, 8,659; Sandusky, 8,459; Eagle Rock, 8,026. The *smallest* are: Phœnix, 1,721; Memphis, 1,860; La Mesilla, 1,981; Florence, 2,164; Silver City, 2,324; San Antonio, 2,595; Uvalde, 2,611; Nashville, 2,663; Deadwood, 2,771; Indianapolis, 2,803.

High Winds.—Winds of 50 miles per hour and over were reported as follows: On summit of Pikes Peak, 10th, a violent hurricane prevailed, reaching a maximum velocity of 112 miles per hour at 12,15 a. m. of the 11th, when the anemometer cups were blown away. From this time

until 2.30 a. m. the wind increased in violence, reaching an estimated velocity of 150 miles per hour. On summit of Mt. Washington, 1st, 2d, 6th, 9th, 10th to 12th, 15th to 19th, 27th, 29th, 30th. Maximum velocity, 78 miles, NW. 2d. Ft. Keogh, 62, NW. 21st; North Platte, 56, S. 16th; Ft. Elliott, 52, NW. 7th, 8th; Ft. Sill, 60, SE. 8th; Decatur, 64, NE. 25th; Indianola, 56, N. 29th; Eastport, 55, NE. 17th.

Local Storms.—Near Pensacola, Fla., 24th, very violent, buildings blown down and many trees up-rooted; rain-fall excessively heavy; Carpenter's Creek overflowed and the ford on the Ferry Pass route was complety changed. McLenan Co., Texas, 28th, p. m., in southern part, several farm houses demolished and two persons killed; storm passed from SW. to NE.; in the northern part of the county, near Crawford, another violent wind storm passed from SW. to NE., unroofing and destroying buildings, and seriously damaging crops. Dallas, Tex., 30th, very violent, unroofing buildings; rain fell in torrents. Taylor, Williamson Co., Tex., 28th, p. m., very violent, lasting forty minutes; every building in the town more or less damaged, many were totally wrecked; in the county along the path of the storm fences were blown down and trees uprooted. Anna, Ill., 14th, heavy wind storm; portion of the Insane Hospital building blown down, and much other property damaged. Chester, Ill., 14th, terrific wind storm, much damage to property in lower part of town; roofs torn off and buildings demolished; considerable loss of property in surrounding country. Laurens Co., Ga., 14th, during the evening, tornado passed from NW. to SE. over the county, destroying everything in its path; the destruction of timber was almost unprecedented; where the storm cloud passed over an oat field, it literally tore up by the roots and carried away the grain over an area 125 yards wide, leaving the standing grain on either side unruffled; the storm was accompanied at many places by heavy hail. North Platte, 9th, twenty miles east of station, demolishing houses, windmills, and the U. P. R. R. depot. Laredo, 8th, unroofing buildings, blowing down signs, trees, &c. Gainesville, Tex., 28th, 7 p. m., blowing down houses, trees and fences. Montgomery, Ala., 31st, blowing down trees, signs and fences. Columbus, Ohio, 14th, 5 to 5.30 p. m., air filled with debris, buildings unroofed, trees, fences and signs demolished. Charlotte, N. C., 15th, 2.50 p. m., unroofing and blowing down large number of buildings, and committing other damage. Clay Center, Kan., 13th, six miles SE. of station tornado passed from SW. to NE., several buildings demolished. Yates Center, Kan., 16th, small tornado passed over Owl Creek Township, nine miles NE. of station, destroying two frame houses; direction of storm centre, SW. to NE. Westerville, Ohio, 14th, centre passed about one mile south of station in a northeasterly direction, blowing down trees, fences and buildings. North Lewisburg, Ohio, 14th, very violent; blowing down trees, buildings and fences; storm passed from SW. to NE. Milton, Pa., 10th, 6.30 p. m., unroofing buildings, up-rooting trees, and blowing down fences.

Water Spouts.—Mobile, 31st, observed in Mobile Bay at 4.30 p. m.; trunk was large and well-defined; moved from southwest to northeast; was visible for 10 minutes. Clay Centre, Kan., 17th, 18th, 19th.

Sand Storms.—Ft. Grant, 14th; Ft. Verde, 10th, 22d; Tucson, 6th to 10th; Camp Thomas, 5th, 6th, 10th, 14th, 19th, 22d, 24th, 25th, 30th; Ft. Yuma, Cal., 9th, 10th, 18th, 21st.

VERIFICATIONS.

Indications.—The detailed comparison of the tri-daily indications for May, with the telegraphic reports for the succeeding twenty-four hours, shows the general percentage of verifications to be 81.66 per cent. The percentages for the four elements are: Weather, 83.86; Direction of the Wind, 76.16; Temperature, 83.86; Barometer, 82.67 per cent. By geographical districts they are: For New England, 79.79; Middle States, 83.55; South Atlantic States, 87.33; Eastern Gulf States, 82.57; Western Gulf States, 88.08; Lower Lake region, 81.68; Upper Lake region, 75.84; Tennessee and the Ohio valley, 80.36; Upper Mississippi valley, 79.98; Lower Missouri valley, 79.90; Northern Pacific coast region, 75.00; Central Pacific coast region, 93.42; Southern Pacific coast region, 73.62. There were 85 omissions to predict (37 being due to the absence of reports from the Pacific coast) out of 3,813, or 2.28 per cent. Of the 3,728 predictions that have been made, 203, or 5.44 per cent, are considered to have entirely failed; 156, or 4.17 per cent, were one fourth verified; 501, or 13.47 per cent, were one-half verified; 421, or 11.29 per cent, were three-fourths verified; 2,447, or 65.63 per cent, were fully verified, so far as can be ascertained from the tri-daily reports.

Cautionary Signals.—24 Cautionary Signals were displayed during the month, of which 21, or 87.5 per cent, were fully justified by winds of 25 miles per hour or over at, or within a radius of 100 miles of the station. One Off-shore Signal was displayed, which was justified both as to direction and velocity. No Off-shore Signals were changed from Cautionary. 25 Signals of all kinds were displayed, of which 22, or 88.0 per cent, were fully justified. The above does not include signals ordered at display stations where the velocity is only estimated. 114 winds, of 25 miles or over, were reported, for which no signals were ordered. 7 signals were ordered late.

NAVIGATION.

Stage of Water in Rivers.—In the table on the right-hand side of Chart No. III are given the highest and lowest stages of water, as observed on the Signal Service river gauges during the month of May, 1881. In the Red and Arkansas Rivers the highest stage was reached between the 3d and 9th. In the Missouri, below Yankton, high water, consequent upon the April floods, did not subside until about May 10th. The highest stage at Omaha and Leavenworth was reached on the 1st, the latter being 41 inches above the danger line and the former within 17 inches of it. In the Mississippi the high water of the April floods did not wholly disappear until about May 15th. The highest stage occurred at St. Paul and Memphis on the 1st, and at New Orleans on the 30th; at other stations between the 5th and 17th. The following stations were above the danger line: St. Paul 50 inches; Keokuk 11 inches; St. Louis 44 inches; Cairo 32 inches and Vicksburg 7 inches. In the Ohio the water at the various stations reached its highest stage between the 7th and 11th, accompanied by no dangerous rises. In the Cumberland, Tennessee, Monongahela and Savannah rivers, the highest stages were reached between the 1st and 7th, the water remaining very low throughout the month. The Williamette at Portland, Oregon, reached its highest stage on the 1st.

Ice in Rivers and Harbors.—St Clair river: Port Huron, 2d, heavy ice running all day; drift-ice, 3d to 12th, disappearing on 13th; 5th, small schooner struck and sunk. *Lake Michigan:* Chicago, 4th, 21st. *Lake Superior:* Marquette, 1st, ice moved out of harbor during morning; 5th, ice returned again; 7th, again passed out, steam barge "Northerner" arrived, first of season, reports very hard trip, working through 60 miles of ice, between here and Sault St. Marie; Duluth, 1st to 8th, ice still in harbor; 5th, mail tug "Siskwirt" left port, first departure; 9th, propellor "Manistee" came in port, first arrival; 9th, ice left harbor. *Green Bay:* Escanaba, 3d, ice moved out, navigation opened; 4th, first arrival. *Lake Erie:* Toledo, 9th, navigation fully open. *Lake Ontario:* Buffalo, 1st, navigation opened; 14th, ice disappeared from lake. *Devils Lake:* Ft. Totten, Dak., 7th, ice breaking up; 9th, almost clear; 10th, entirely clear.

Floods.—The terrible devastation caused by the high water in April ceased for the most part with the closing days of the month, although at some points along the Mississippi, notably in the vicinity of St. Louis, the river continued to rise until May 6th, when at that city it was over three feet above the danger line. As will be shown by the dates of lowest water, the effects of the unprecedented floods of April continued their influence upon the Mississippi to a much later period than in the Missouri; the former at every station but two (Dubuque and New Orleans) reached its lowest stage on May 31st, while in the latter it occurred between the 16th and 22d. Floods elsewhere noted were due entirely to the unusually heavy rains of May. *Dakota:* 14th, reports from the recently flooded districts in this state and Nebraska give a most deplorable picture of the country. In northern Nebraska and southern Dakota houses were found scattered around in every conceivable shape; thousands of trees stripped of bark and limbs, and cotton wood trees two to three feet in diameter were uprooted; thousands of acres of once beautiful farms apparently converted into barren sand bars and vast lakes of water. At the town of Green Island, where but one solitary house remained, huge cakes of ice were still found. Springfield, 26th, Emanuel creek rose 10 feet during the night, caused either by a "cloud burst" or exceedingly heavy rains up the valley. Five buildings were carried away and all the bridges along the creek. Two persons were drowned. 2,800 feet of railroad embankment was washed out, carrying away the rails and ties. *Iowa:* Dubuque, 11th, water 16 feet 7 inches above low water mark, or six feet lower than the great rise of June, 1880. No serious damage yet, but many mills obliged to shut down. Keokuk, 14th, Keokuk and St. Louis Railroad flooded near Gregory's Landing, where the track was several feet under water. *Idaho:* Eagle Rock, 4th, first mail since April 26th, owing to high water on the Portreuf and Snake rivers. *Kansas:* Dodge City, 14th, Arkansas river overflowed its banks for the first time within the memory of the oldest inhabitants. Yates Center, 19th, 20th, very heavy rains, river overflowed; dam at Neosha falls swept away. *Louisiana:* Alsatia, 5th, levee broke; river over a mile wide, 22 inches deep at points along the Vicksburg and Shreveport railroad. *New Brunswick:* New Castle, 21st, Miramichi river and its tributaries higher than for many years; considerable damage caused to logging interests; overflow due to the heavy rains of past week, together with the rapid melting of large quantities of snow in the forests. *Missouri:* St. Louis, 2d, water in river one foot and a half above the danger line and still rising; low lands south of Choteau avenue and east of the high embankment of the Iron Mountain railroad submerged; the Meier Iron Works on the eastern side of the river opposite Carondalet surrounded by water; operations suspended; most of the lumber yards flooded; Cahokia Creek overflowed, submerging a large extent of territory in the neighborhood of Brooklyn and Venice (two small towns north of East St. Louis); many houses abandoned. 3d, water still rising slowly; East Carondalet entirely submerged; 200 persons leaving their houses; in northern part of city about fifteen industrial establishments were obliged to suspend operations; the situation in East St. Louis remains about the same. 5th, levee along the river bank opposite Nameokie, broke during the morning, overflowing all the bottom lands between the Chicago and Alton rail-

road track and the river; crevasse 50 feet wide and several feet deep; no change at East St. Louis. 6th, Madison levee broke about 4 a. m.; crevasse 50 feet wide; the settlements of Canteen and Indian creeks flooded; about 15,000 acres of farming land under water. Hannibal, 6th, the break in the Sny levee stopped during the night; water in the submerged districts receded ten inches within an hour. *Nebraska:* Omaha, 13th, very heavy rains; streets and cellars flooded. *Wisconsin:* La Crosse, 2d, river 11 feet 7 inches above low-water mark, and rising slowly; both railroad tracks covered with water; all traffic stopped; river filled with old snags, piles of brush, logs and driftwood; current very rapid.

TEMPERATURE OF WATER.

The temperature of water, as observed in rivers and harbors at Signal Service stations, with the average depth at which observations were taken, is given in the table on the left-hand side of chart No. III. Owing to breakage of instruments, observations are wanting of follows: Savannah, 1st to 12th; San Francisco, 1st to 31st.

ATMOSPHERIC ELECTRICITY.

Thunder-storms.—In the various districts they were reported on the following dates: New England, 2d, 5th, 6th, 8th to 13th, 15th to 18th, 22d to 24th, 25th, 27th, 29th, 30th, 31st. Middle Atlantic States, 2d, 9th, 10th to 16th, 20th, 21st, 22d, 26th to 31st. South Atlantic States, 2d to 4th, 6th, 10th, 13th to 17th, 19th, 22d to 25th, 28th to 31st. Florida, 2d, 5th, 6th, 14th, 15th, 20th, 22d, 26th to 31st. Eastern Gulf States, 1st to 11th, 14th, 15th, 21st to 26th, 29th, 30th, 31st. Western Gulf States (including Texas), 1st to 12th, 16th to 31st. Ohio valley and Tennessee, 1st to 10th, 12th to 14th, 22d to 24th, 26th to 31st. Lower Lake region, 5th, 8th to 14th, 28th, 31st. Upper Lake region, 7th to 9th, 11th to 14th, 26th, 27th, 29th, 31st. Upper Mississippi valley, 1st, 2d, 4th, 7th to 14th, 16th, 19th, 21st to 31st. Lower Missouri valley, 1st to 23d, 26th to 31st. Southern Slope, 1st to 3d, 12th to 15th, 17th, 18th, 22d, 24th, 25th. Middle Slope, 1st, 6th, 8th, 9th, 10th, 15th, 16th, 23d to 26th, 28th to 30th. Northern Slope, 3rd, 4th, 6th, 8th, 9th, 10th, 15th, 22nd, 24th to 31st. Southern Plateau, 14th, 15th. Middle Plateau, 9th, 10th, 15th. Northern Plateau, 3rd, 4th, 8th, 12th, 20th, 22nd, 27th, 30th. Southern Pacific Coast region, 14th, 15th, 16th, 17th. Middle Pacific Coast region, 1st, 15th, 21st to 24th. Northern Pacific Coast region, 27th.

The following items of interest connected with the peculiar manifestations of electricity during the progress of thunder-storms were obtained from various sources: Manhattan Beach, Coney Island, N. Y., 12th, late in the afternoon a thunderbolt descended among a gang of 15 laborers, killing one of them instantly, seriously injuring another, whose hair was almost entirely burned off, and severely stunning the remainder. Hartford, Conn., 12th, six barns and one house struck and burned; loss about $12,000. Columbia, S. C., 31st, atmosphere appeared to be unusually charged with electricity. One explosion after another followed in quick succession, and at times the heavens seemed to be on fire. One residence was struck, the electricity making quite a hole in the roof and scattering the shingles in the street. The wainscoting and cornices in the parlor were knocked from their places and broken and the papering was scorched and smoked. The ceiling above was perforated at two points on opposite sides of the room. The current descended the lightning-rod, tore up the pavement in the yard scattering the bricks about and bursted the water pipe in the basement. The water main in the middle of the adjoining street, and over 30 feet from the house, was broken in three places, causing the water to rush out in great force. Several persons were more or less stunned. Fort Stockton, Tex., 17th, infantry quarters struck, tearing the plaster from the walls and slightly injuring one man; 18th, the lightning knocked a gun from the hands of one of the men, throwing it several yards away; an officer, while crossing the parade ground at the same time, received a slight shock and was obliged to cast away his sabre to prevent the electricity from playing around him. Boston Mountain, Ark., 14th, two men killed while plowing in a field, the stroke fracturing every bone in their bodies. Springfield, Dak., 26th, two buildings struck; in the first, the electricity passed down one of the chimneys, forcing out the gable end of the building; it then proceeded through the floor into the kitchen, tearing the plastering off the ceiling and turning a large cook stove completely around. The second building was struck upon the ridge, the electricity passing downward through the centre of the house, carrying away the whole front end. The occupants of both houses received but slight shocks. San Antonio, Tex., 5th, switch boards damaged by lightning; stable and horses burned. Galveston, 8th, several persons severely shocked. St. Paul, 14th, barn struck, killing 25 horses, several other buildings damaged. La Crosse, 28th, church spire entirely demolished. Memphis, 22d, struck iron foundry, completely destroying new lightning-rod. Albany, 25th, several buildings shattered. Boston, 30th, barn struck, several persons killed and injured. Fallston, Md., 31st, two miles northeast of station, barn struck and burned. horses and cattle killed in the field. Cincinnati, 11th, several buildings struck. Columbia, S. C., 28th, two women struck, tearing the shoes from the feet of one of them, but neither were killed.

Atmospheric Electricity Interfering with Telegraphic Communication.—Ft. Keogh, 31st, lightning very vivid and almost continuous, but no audible thunder, had to cut out instruments. Deadwood, 24th, 25th, 26th; Ft. Griffin, 24th, 25th; Jacksboro, 3d, 4th, 11th, 26th to 28th; Eagle Pass, 4th, 5th, 7th, Castroville, 5th to 7th, 17th, 18th, 28th, 29th; San Antonio, 28th, 29th; Ft. McKavett, 3d, 17th, 18th; Brackettville, 3d, 4th, 5th, 7th, 18th; Ft. Elliott, 12th; Mt. Washington, 10th.

Ground Currents.—Dayton, Wash. Ty., 30th; Deadwood, 23d.

Auroras.—No auroral manifestation of particular importance was observed during the month, save, perhaps, that of the 15th, which extended from northern Michigan to southwestern Dakota, and northward to Manitobia, five intervening stations reporting. The display began about 9 p. m. and ended between 10.30 and 11 p. m. The following were local displays: Woodstock, Vt., 9th, 3 a. m., seen through broken clouds. New Haven, 24th, 7.30 to 9 p. m., was seen in the northeast, altitude 30°. Rochester, 12th, 11.40 p. m. to 2 a. m. of the 2d, at times flashes of light would illumine the heavens, alternating with heavy darkness, produced by the interference of clouds; no segment visible. Alpena, 4th, from 8.10 to 8.50 p. m., diffuse light, without streamers; 16th, 8.15 to 10.30 p. m., faint beams, altitude from 15° to 40°, width about 1°, apparently moving from west to east; 18th, 8 to 9.15 p. m., diffuse light, without streamers. Cresco, Ia., 16th, 9. 25 to 10 p. m., faint beams between north and northeast. Mission House, Wis., 15th, 24th and 28th, very dim, altitude about 30°, no cloud below arch.

Zodiacal Light.—Wabash, Ind., 16th; Cresco, Ia., 15th and 16th; Clinton, Ia., 14th, 15th, 16th and 17th; Monticello, Ia., 15th, 17th, 19th and 22d; Clear Creek, Neb., 16th and 24th; Atco, N. J., 15th, 26th, 28th and 29th; Nashville, 15th, 17th, 19th, 20th 26th, 27th and 28th.

OPTICAL PHENOMENA.

Solar halos have been observed in the various districts on the following dates: New England, 1st to 5th, 12th to 14th and 29th. Middle Atlantic States, 1st to 5th, 11th and 12th. South Atlantic States, 11th, 25th and 30th. Florida, 20th and 31st. Eastern Gulf States, 4th, 7th and 19th. Texas, 15th. Ohio valley and Tennessee, 1st, 3d to 6th, 10th, 12th, 13th, 20th, 21st and 24th. Upper Lake region, 1st to 4th, 6th, 9th, 11th and 12th. Lower Lake region, 1st, 2d and 5th. Upper Mississippi valley, 3d, 5th, 10th, 20th, 21st, 24th and 26th. Middle Slope, 3d to 6th, 9th, 13th, 24th and 27th. Middle Plateau district, 4th to 8th, 14th, 24th and 29th to 31st. Northern Plateau district, 1st to 3d, 7th, 10th to 12th, 20th, 23d, 29th and 31st. Northern Pacific Coast region, 2d, 6th, 10th, 11th, 17th, 18th, 20th and 29th, 30th. California, 2d, 4th, 7th, 11th, 15th, 19th, 20th, 23d, 26th, 29th and 30th.

Lunar halos have been observed in the various districts on the following dates: New England, 5th, 8th and 11th. Middle Atlantic States, 3d, 4th, 7th, 8th, 10th to 13th, 29th and 31st. South Atlantic States, 12th and 13th. Eastern Gulf States, 3rd, 4th, 6th, 7th and 10th. Western Gulf States and Texas, 3d to 9th, 11th to 13th and 31st. Ohio valley and Tennessee, 3d to 6th, 8th, 12th and 13th. Lower Lake region, 1st, 4th, 6th, 8th, 10th and 31st. Upper Lake region, 1st to 4th, 12th. Upper Mississippi valley, 5th, 6th, 7th, 10th, 13th and 14th. Lower Missouri valley, 6th and 16th. Southern Plateau, 3d, 4th, 5th, 7th, 8th and 9th. Nothern Pacific Coast region, 3d, 6th and 22d. California, 4th, 7th, 11th and 15th.

Polar Bands.—New Corydon, Ind., 3d; Gardiner, Me., 1st; Fayette, Miss., 12th; Almota, Wash. Ty., 17th; Memphis, 12th.

Mirage.—Indianola, 14th, 15th, 17th, 19th and 31st. Milwaukee, 18th, very beautiful, was witnessed over Lake Michigan; ships could be seen, apparently sailing in the sky with masts pointed downward. The distance of the vessels must have been great, but the reflection showed them as plainly as if they had been in close proximity. New Haven, 12th, very beautiful, magnifying the vessels at anchor: the hull of an incoming brig appeared in the distance 40 feet high.

MISCELLANEOUS PHENOMENA.

Meteors.—Almota, Wash, Ty., 18th. Boise City, 3rd. Ft. Stevenson, 2d, very brilliant observed about 8 p. m. in the southern heavens; first appeared about 5° above the horizon and inclined south and downward; its flight lasted about 5 seconds, leaving a faint train; in size, it was apparently, nearly equal to that of the full moon. Fredericksburg, Tex., 22d, 10:10 p. m., altitude 45°, direction from northwest to southeast: as it passed along it gave a light much brighter than the stars, leaving a trail of dark blue color and exploded apparently into three balls of fire. Davenport, 22d. Washington, D. C., 9th, 9:45 p. m., appeared 45° above southeastern horizon, pursued a northwesterly course through zenith; extent of its visible path was about 20°. Wood's Holl, 3d, 2:10 a. m., from east to west. Woodstock, Md., 17th, 9 p. m.; 23d, 9 p. m., from southeast to northwest; 24th, 8:35 p. m, from west to east. Williamstown and Fall River, Mass..13th. Thornville, Mich., 27th. Fayette, Miss., 1st. Atco, N. J., 22d, 24th. North Volney, N. Y., 23d. Waterburg, N. Y., 2d. Little Mountain, Ohio, 7th. Mission House, Wis., 2d.

Earthquakes.—La Salle, Ill., 25th, during the night a slight shock was distinctly felt in the manufacturing area, between the bluffs and the canal, in the southwestern part of the city. Six fissures, measur-

ing from one-half to two inches in width, and traceable for a distance of about 600 feet were produced, running nearly parallel from northwest to southeast. The walls, foundations and furnaces in the bottle and window glass factories were cracked in numerous places, and estimated to have sunk six inches. Ft. Gaston, Cal., 10th, 9.09 p. m., vibration from northeast to southwest; windows rattled and furniture in hospital was shaken up as if a heavy piece of ordnance had been discharged in the immediate vicinity; duration, a few seconds; no sound heard. Campo, Cal., 13th, slight shock about 2 a. m.; appeared to pass from southeast to northwest.

Insects.—Chinch Bug: Vandalia, Ill., 22d, in great numbers; much damage to corn. Salem, Ill., 23d, wheat fields alive with them; crop a total loss; farmers afraid to plant corn. Carlinville, Ill., 23d, great damage to wheat crop; hundreds of acres being plowed up. *Hessian Fly:* Vandalia, Ill., 23d, in great numbers; much damage to wheat. *Army Worm:* Anna, Ill., 23d, much damage to wheat, grass and young corn. *Thirteen-year Locusts:* Little Rock, Ark., 23d, great numbers reported from various portions of the State. Swanwick, Ill., appeared on 17th. Pierce City, Mo., 15th, appeared in great numbers. *Cut Worm:* Little Rock, Ark., 23d, cotton completely destroyed on many large plantations. *Potato Bugs:* Creswell Kansas, 21st, observed in small numbers. Heath, Mass., numerous during latter part of month. Flushing, N. Y., appeared on 15th. Blooming Grove, Pa., appearing in great numbers. West Chester, Pa., more numerous than ever before seen.

Sunsets.—The characteristics of the sky at sunset, as indicative of fair or foul weather for the succeeding twenty-four hours, have been observed at all Signal Service stations. Reports from 181 stations show 5,580 observations to have been made, of which 27 were reported doubtful; of the remainder 5,553, or 84.5 per cent.; were followed by the expected weather.

The following data, furnished by E. V. Berthoud, C. E., Golden, Col., is indicative of the relative rain-fall in different seasons, and bears especially upon the important question of water supply for irrigation. The following cross sections and gauges of Clear Creek have been taken, always at the same spot, in continuation of a series that now extends over a space of twenty-one years. Clear Creek is one of the main affluents of South Platte River, and has a watershed of four hundred square miles. The observations relate to a point in latitude 39° 45′ 24″, longitude 115° 8′ 3″, altitude, 5,700 feet.

Date.	Width of water prism. ft.	Area. sq. ft.	Mean vel. of stream. ft. per sec.	Tot. discharge in c. ft. p. sec
Feb. 20, 1880....	27.10	26.10	2.00	52
March 22, 1880..	31.00	25.72	2.06	53
March 30, 1880..	32.00	23.50	2.46	58
May 5, 1880.....	35.00	41.20	2.31	95
Sept. 15, 1880...	34.00	38.22	2.23	85
Oct. 21, 1880....	35.00	39.15	2.52	99
March 25, 1881..	32.00	35.79	3.01	107
May 4, 1881.....	52.00	86.20	5.10	440
June 6, 1881.....	55.00	196.20	8.17	1,603

Sun Spots.—The following record of observations, made by Mr. D. P. Todd, Assistant, has been forwarded by Prof. S. Newcomb, U. S. Navy, Superintendent Nautical Almanac Office, Washington, D. C.

Date—May, 1881.	No. of new—		Disappeared by solar rotation.		Reappeared by solar rotation.		Total number visible.		Remarks.
	Groups	Spots.	Groups	Spots.	Groups	Spots.	Groups	Spots.	
1, 9 a. m.....	0	0	1	1	0	2	1	6	
5, 7 a. m.....	4	9	0	0	.....	.....	5	15	
7, 9 a. m.....	0	0	1	2	0	0	4	13	
8, 9 a. m.....	0	5	0	0	0	0	4	18	
5 p. m.....	0	7	0	0	0	0	4	25	Many of the spots small.
9, 8 a. m.....	0	0	0	0	0	0	4	18	
10, 9 a. m.....	1	3	0	3	1	3	5	18	
11, 9 a. m.....	0	7	1	4	0	7	3	17	
12, 9 a. m.....	1	10	1	2	1	10	2	20†	
13, 8 a. m.....	1	2	0	0	1	2	3	22†	
14, 8 a. m.....	0	0	0	0	0	0	3	15†	
15, 9 a. m.....	0	0	0	0	0	0	2	8	
16, 12 m.....	2	5	0	0	1	2	4	8	
22, 10 a. m.....	0	0	0	0	0	0	3	9	
23, 8 a. m.....	1	5	0	0	0	0	4	16	
24, 6 a. m.....	0	10	0	0	0	0	4	26†	
25, 8 a. m.....	0	10	2	6	0	0	2	30†	
26, 6 a. m.....	1	7	0	0	1	7	3	37†	
27, 8 a. m.....	1	7	0	0	0	6	4	44†	Many of the spots small.
28, 8 a. m.....	0	12	0	0	0	12	4	56†	
29, 9 a. m.....	0	0	0	8	0	0	4	48†	
30, 8 a. m.....	2	15†	0	7	1	1	6	60†	
31, 7 a. m.....	0	10	1	5	0	4	5	65†	Faculæ were seen at the time of every observation

† Approximated.

Mr. William Dawson, at Spiceland. Indiana, reports as follows: 6th, 4 groups, 9 spots, 2 large ones near east side; 8th, 5 groups, 6 spots; 11th, 4 groups, 25 spots, 3 large ones in one group near east side, one large spot very close to west edge; 13th, 3 groups, 34 spots; 15th, 2 groups, 6 spots, large spot near centre, two spots near east edge; 17th, 4 groups, 13 spots; 19th, 3 groups, 18 spots; 22d, 4 groups, 30 spots; 25th, 5 groups, 38 spots; 27th, 4 groups, 80 spots, 40 spots in one group just north of centre, new group 20 spots at east side; 31st, 4 groups, 65 spots, one large group of 55 spots, 4 of them large and visible to naked eye, in southeast quadrant. Mr. H. D. Gowey, at North Lewisburg, Ohio, reports: Observed on every day, except 1st, 3d, 5th, 16th, 17th and 18th, when it was cloudy; most numerous on 27th, 28th and 29th; one exceedingly large on 30th and 31st. Mr. J. M. Partrick, at North Volney, N. Y., reports as follows: observed on the 4th; 7th, 4 groups, 5 spots; 9th, 3 groups; 10th, 1 group; 13th, 1 group; 14th, 2 groups; 23d, 3 groups; 24th, 2 groups; 25th, 2 groups; 27th, 3 groups, 15 spots.

NOTES AND EXTRACTS.

[From Nature, March 10, 1881.]

Siberian Meteorology.—Up to the present time Yakutsk, in Northeast Siberia, has often been cited as the place of our earth where the winter is coldest, while the minima observed during Arctic expeditions are believed to be the lowest known. Neither the one nor the other is true. In Maak's book, "Olekminski Okrug," I find many data which prove that the coldest winter as well as the lowest well authenticated minima were observed at Werkhojansk, to the northeast of Yakutsk. The name of the author gives us some guarantee that the observations are trustworthy. I give below the minima at some places cited by Maak, and compare them with those observed in Central and Western Siberia, and the Arctic Archipelago of America:

Northeast Siberia.

Serdze-Kamen	67°	N. 173° E. (Nordenkjöld)	—50.3 F.
Yakutsk	62°	N. 130° E. (Maak)	—77.3 F
Wiljuisk	64°	N. 122° E. (Maak)	—76.3 F.
Werkhojansk	67⅞°	N. 134° E. (Maak)	—81.0 F.

Central and West Siberia.

Yenisseisk	58⅛°	N. 92° E.	—73.5 F.
Barnaul	53⅛°	N. 84° E.	—61.4 F.

Arctic Archipelago.

British expeditions, 1875-76.	83½°	N. Floeberg Beach (Nares)	—73.7 F.
	81½°	N. Discovery Bay (Nares)	—70.7 F.

The temperatures at Werkhojansk are the lowest of all given here, and it must be borne in mind that the observations lasted but one year, while we have more than thirty-five years at Yakutsk, and eight and a half at Yenisseisk. The mean temperatures are as follows:

	Year.	July.	Nov.	Dec.	Jan.	Feb.	March.
Serdze Kamen, 1 year	.....	.....	2.1	— 9.0	—13.1	—13.2	— 6.9
Ustjansk, 2 years	2.8	52.7	— 2.2	—33.0	—38.9	—36.9	—17.5
Werkhojansk, 1 year	4.3	60.1	—29.2	—46.8	—55.5	—54.5	—29.0
Yakutsk, 10 years*	12.2	64.5	—20.5	—41.9	—46.8	—37.7	— 0.0
Yakutsk, 24 years†	12.4	63.3	—19.1	—37.8	—41.4	—30.8	— 8.7
Floeberg Beach, 1 year	—3.5	38.3	—16.8	—22.2	—33.0	—38.0	—39.8
Discovery Bay, 1 year	—4.2	37.2	—18.4	—24.5	—40.7	—35.0	—37.4

* According to Maak † Old series of Neverof, (1829–54.)

Though the observations were made only during one year at Werkhojansk, it is probable that it would have the coldest winter of all observed till now, as even at Yakutsk, which is the next coldest, January and February were in no single year colder than at Werkhojansk in 1869. From a comparison with the other stations of Northeast Siberia it is probable that here in 1869 February was too cold and December too warm.

Now as to the reason why the winter should be colder in Northeast Siberia than on the North American Archipelago farther to the north, it is to be found in the extent of the continent, the distance from any sea open in winter, and the prevailing calms. How important is the last reason is best seen by the comparison of the December and January temperatures of the last British expedition. The more northerly Floeberg Beach is warmer, because more exposed to winds. Now in Eastern Siberia calms prevail to a large extent in winter, except near the coast.

There is a phenomenon to be considered, which is noticed everywhere in winter in high latitudes: during calms with clear sky the valleys are colder than the surrounding hills and slopes, because the cold air sinks downward and stagnates there. This is confined to the night where the mid-day sun rises high enough, but in high latitudes during some months the mid-day heat of the sun is too small and the day too short to interfere much with the equilibrium of the strata of air established during the night. Even in middle latitudes, (45°–50°,) when calms and clear weather prevail very largely in December, the valleys are regularly colder than the hills. So it was felt in December, 1879, in Central Europe. What is an exception here is a rule in Northeast Siberia, because calms and clear sky are the rule in winter; the valleys are much colder than the hills. On this account the exceedingly low temperature of Werkhojansk in winter is probably not common to the whole surrounding country, and especially in the mountains rising to a short distance south, we may expect a much higher temperature. The more we consider the conditions of the winter temperature of Northeast Siberia, the more difficult it seems to draw isotherms. We know that plains and valleys there, are much colder than hills and mountain-slopes, but how much, and what conditions are most favorable to that so-called interversion of temperature? I consider it as highly probable that both at Yakutsk and at Werkhojansk the local topographical conditions are very favorable to winter cold. This being the case, it is quite natural that the latter place is colder in winter than the former, being situated 5° farther to the north, and yet far enough from the west to have a continental climate.

A. WOEIKOF.

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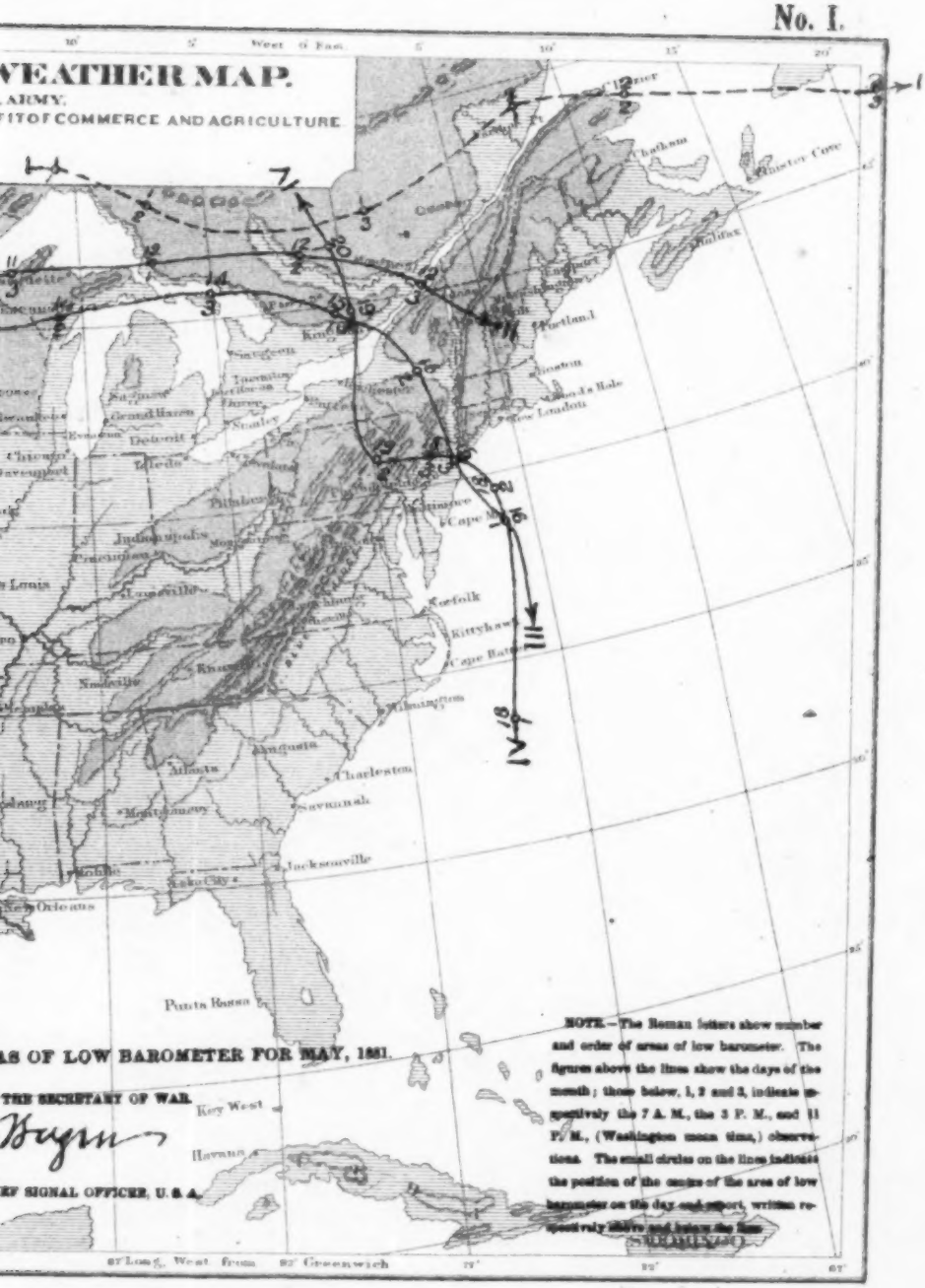
WAR DEPARTMENT WEAT
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF COM
Ft Benton
Bismarck
Duluth
Ft Sully
St Paul
Salt Lake City
Cheyenne
North Platte
Omaha
Denver
Kansas
Pike's Peak
St Louis
Santa Fe
Cairo
San Francisco
San Diego
Ft Sill
Memphis
Galveston
Indianola
AVERAGE PROGRESS OF AREAS OF LOW BAROMETER EAST OF THE 100TH MERIDIAN.
No. | Velocity.
I. 40 miles per hour.
II. 46 do.
III. 26 do.
IV. 27 do.
V. 13 do.
TRACKS OF CENTRES OF AREAS OF L
PUBLISHED BY ORDER OF THE SECR
W. B. Hug
BRIG. & BVT. MAJ. GEN'L, CHIEF SIGNAL

No. I.


VEATHER MAP.
ARMY,
FITOF COMMERCE AND AGRICULTURE
Portland
Boston
New London
Norfolk
Kittyhawk
Cape Hatteras
Wilmington
Augusta
Charleston
Savannah
Jacksonville
Key West
Havana
Punta Rasa
AS OF LOW BAROMETER FOR MAY, 1881.
THE SECRETARY OF WAR.
EF SIGNAL OFFICER, U.S.A.
NOTE.—The Roman letters show number and order of areas of low barometer. The figures above the lines show the days of the month; those below, 1, 2 and 3, indicate respectively the 7 A. M., the 3 P. M., and 11 P. M., (Washington mean time,) observations. The small circles on the lines indicate the position of the centre of the area of low barometer on the day and report, written respectively above and below the line.
87 Long. West from 82° Greenwich

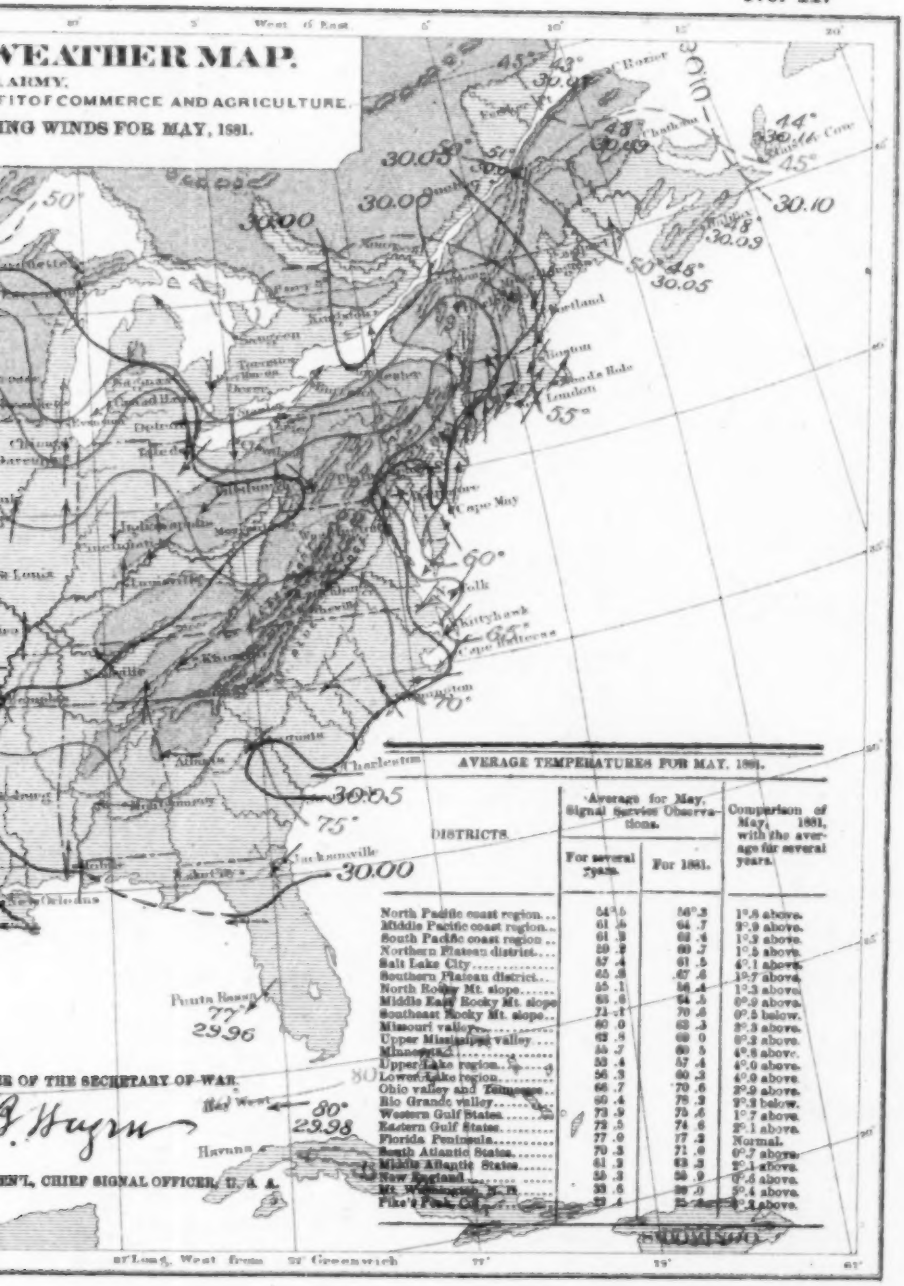
WAR DEPARTMENT WEAT
SIGNAL SERVICE, U.S. ARMY.
DIVISION OF TELEGRAMS AND REPORTS FOR THE BENEFIT OF CO
ISOBARS, ISOTHERMS AND PREVAILING WIN
PUBLISHED BY ORDER OF THE
W. B. Ha
BRIG. & BVT. MAJ. GEN'L, CHIE

TEMPERATURE OF WATER FOR MAY, 1870.

STATIONS.	Temperature at Sunset. Max.	Temperature at Sunset. Min.	Average daily range of temperature for the month.
Atlantic City	69°	57	3.0
Alpena	61	43	17.0
Augusta	81	63	17.4
Baltimore	79.5	63	16.0
Boston	68.5	49.5	19.0
Buffalo	63	46	15.0
Burlington, Vt.	67	47	20.1
Cedar Keys	83	72	11.0
Charleston	79	72	7.5
Chicago	64	47	8.0
Chincoteague	80	58	1.0
Cleveland	68	47	14.0
Detroit	69	51	15.10
Duluth	60	37	14.0
Del. Breakwater	69	51	6.5
Eastport	63	47	17.0
Escanaba	54	34	17.0
Galveston	90	73	13.5
Grand Haven	77	57	19.5
Indianola	—	—	—
Jacksonville	93	77	16.0
Key West	93	78	12.5
Marquette	62	36	9.4
Milwaukee	63	47	9.0
Mobile	93	73	20.0
New Haven	68	50	13.7
New London	70	43	13.6
Newport	68	44	10.0
New York	84	50	17.7
New Shoreham	64	43	9.2
Norfolk	78	63	13.0
Pensacola	91	70	17.0
Portland, Maine	64	44	20.0
Portland, Or.	82	44	26.0
Port Eads	75	56	9.6
Point Reuse	84	73	11.6
Sandusky	73	53	10.0
Sandy Hook	69	48	5.6
San Francisco	—	—	—
*Savannah	77	71	13.6
Smithville	72.5	67	10.0
Thatcher's Island	61	39	7.0
Toledo	70	50	13.0
Wilmington	74.5	70	13.0
Woods' Holl	69	48	9.0

* Observations for only part of month—See text.

No. II.


WEATHER MAP.
ARMY.
FIT OF COMMERCE AND AGRICULTURE.
ING WINDS FOR MAY, 1881.
30.00
30.05
30.10
30.09
30.05
30.05
30.00
29.96
29.98
Havana
Key West
Jacksonville
Charleston
Cape May
Kittyhawk
Cape Hatteras
Portland
Boston
Rhode Isle
London
Detroit
Toronto
Grand Haven
Chicago
Milwaukee
Duluth
Port Huron
Cleveland
Buffalo
Rochester
Oswego
Albany
Montreal
Quebec
Halifax
Eastport
Portland
Bangor
Mt. Washington
Chatham
Block Island
Cape Race
Sydney
Louisville
Cincinnati
Indianapolis
Columbus
Pittsburg
Wheeling
Harrisburg
Philadelphia
New York
Washington
Baltimore
Richmond
Norfolk
Lynchburg
Knoxville
Nashville
Memphis
Atlanta
Montgomery
Vicksburg
New Orleans
Mobile
Pensacola
Tallahassee
Savannah
Charleston
Wilmington
Raleigh
Charlotte
Augusta
Columbia
Macon
Jacksonville
Key West
Havana
Pinar del Rio
Matanzas
Cienfuegos
Santiago
Nassau
Turks Island
Port au Prince
Kingston
Jamaica
Cape Haytien
Porto Rico
Ponce
San Juan
St. Thomas
Barbados
Trinidad
Grenada
Martinique
Guadeloupe
Antigua
St. Kitts
Dominica
St. Lucia
St. Vincent
Tobago
Curaçao
Aruba
Maracaibo
Puerto Cabello
La Guayra
Caracas
Cumana
Barcelona
Carupano
Trinidad
Port of Spain
Grenada
Martinique
Guadeloupe
Antigua
St. Kitts
Dominica
St. Lucia
St. Vincent
Barbados

AVERAGE PRECIPITATION FOR MAY.

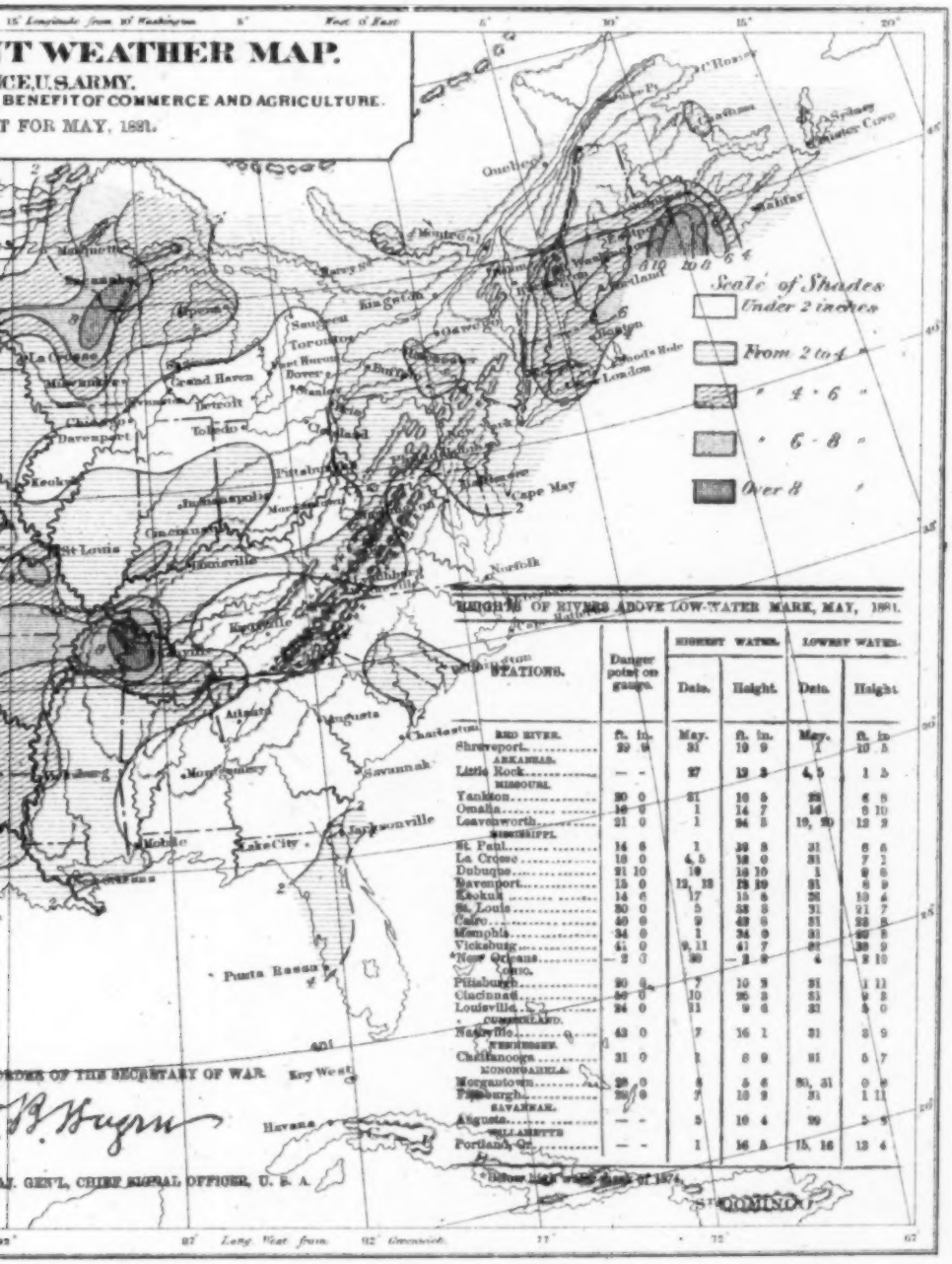
DISTRICTS.	Average for May. For 10 or 20 years.	For 1881.	Comparison of May, 1881, with the average for many years.
	Inches.	Inches.	Inches.
New England	2.77	4.61	1.84 excess.
Middle Atlantic States	2.95	2.18	0.77 deficiency.
South Atlantic States	2.91	1.64	1.27 deficiency.
Florida Peninsula	3.56	3.00	0.56 deficiency.
Eastern Gulf States	4.37	2.36	2.01 deficiency.
Western Gulf States	4.37	6.01	1.64 excess.
Tennessee	3.39	2.66	0.73 deficiency.
Ohio Valley	3.26	2.74	0.52 deficiency.
Lower Lake Region	2.57	2.31	0.26 deficiency.
Upper Lake Region	3.06	2.92	0.14 deficiency.
Upper Mississippi Valley	3.09	2.71	1.38 deficiency.
Minnesota	3.72	3.22	0.50 deficiency.
Lower Missouri Valley	4.34	5.18	0.84 excess.
Upper Missouri Valley	2.21	2.80	0.59 excess.
North Pacific Coast Region	2.68	1.22	1.46 deficiency.
Middle Pacific Coast Region	0.88	0.34	0.54 deficiency.
South Pacific Coast Region	0.18	0.18	Normal.

T WEATHER MAP.

CE, U.S. ARMY.

BENEFIT OF COMMERCE AND AGRICULTURE.

T FOR MAY, 1881.



ORDER OF THE SECRETARY OF WAR.

B. Hagan

A. GEN'L, CHIEF SIGNAL OFFICER, U. S. A.

HEIGHTS OF RIVERS ABOVE LOW-WATER MARK, MAY, 1881.

STATIONS.	Danger point on gauge.	HIGHEST WATER. Date.	HIGHEST WATER. Height.	LOWEST WATER. Date.	LOWEST WATER. Height.
RED RIVER.	ft. in.	May.	ft. in.	May.	ft. in.
Shreveport	29 0	31	19 9	1	10 5
ARKANSAS.					
Little Rock	— —	27	13 3	4, 5	1 5
MISSOURI.					
Yankton	20 0	31	10 6	23	6 8
Omaha	16 0	1	14 7	16	8 10
Leavenworth	21 0	1	24 5	19, 20	12 2
MISSISSIPPI.					
St. Paul	14 6	1	30 8	31	6 6
La Crosse	18 0	4, 5	18 0	31	7 1
Dubuque	21 10	10	16 10	1	9 6
Davenport	15 0	12, 13	15 10	31	8 9
Keokuk	14 6	17	15 6	28	10 4
St. Louis	30 0	5	33 3	31	21 7
Cairo	40 0	9	42 6	31	32 5
Memphis	34 0	1	34 0	31	27 5
Vicksburg	41 0	9, 11	41 7	31	30 9
*New Orleans	— 3 0	30	— 3 6	4	— 3 10
OHIO.					
Pittsburgh	30 0	7	10 3	31	1 11
Cincinnati	50 0	10	25 3	31	9 3
Louisville	24 0	11	9 6	31	3 0
CUMBERLAND.					
Nashville	43 0	7	16 1	31	3 9
TENNESSEE.					
Chattanooga	31 0	1	8 9	31	5 7
MONONGAHELA.					
Morgantown	25 0	4	5 6	30, 31	0 9
Pittsburgh	25 0	7	10 9	31	1 11
SAVANNAH.					
Augusta	— —	5	10 4	29	5 5
WILLAMETTE.					
Portland, Or.	— —	1	16 5	15, 16	13 4

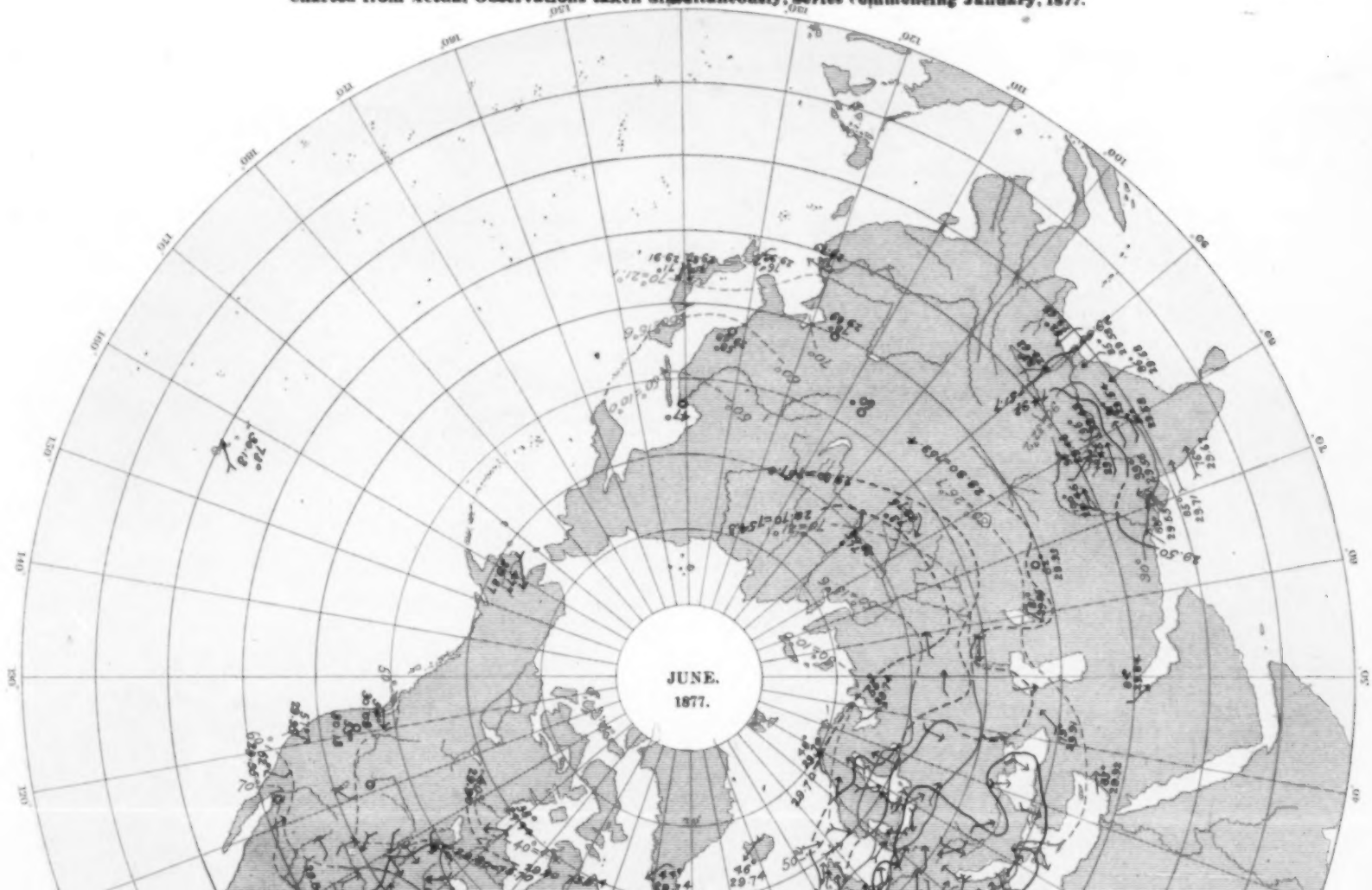
*Below high water mark of 1874.

Office of the Chief Signal Officer,

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing January, 1877.

No. V.



PREVAILING WINDS.

Arrows show the direction of, and fly with, the wind. Force is shown as follows:

Symbols.	Force.	Velocity.	
		Miles per hour.	Metres per second.
	1, 2	0 to 9	0 to 4.0
	3, 4	9.1 to 22.5	4.1 to 10.1
	5, 6	22.6 to 40.5	10.1 to 18.1
	7, 8	40.6 to 67.5	18.1 to 30.2
	9, 10	67.6 up.	30.2 & over.

PUBLISHED BY ORDER OF THE SECRETARY OF WAR

W. B. Hazen

Brig. & Bvt. Maj. Gen'l,
Chief Signal Officer, U. S. A.

ISOBARS AND ISOTHERMS.

Isobars in *blue*; detached barometer means in English inches.

Isotherms in *red*; detached temperature means in degrees Fahrenheit.

Broken lines, are doubtful.

INTERNATIONAL MONTHLY CHART.

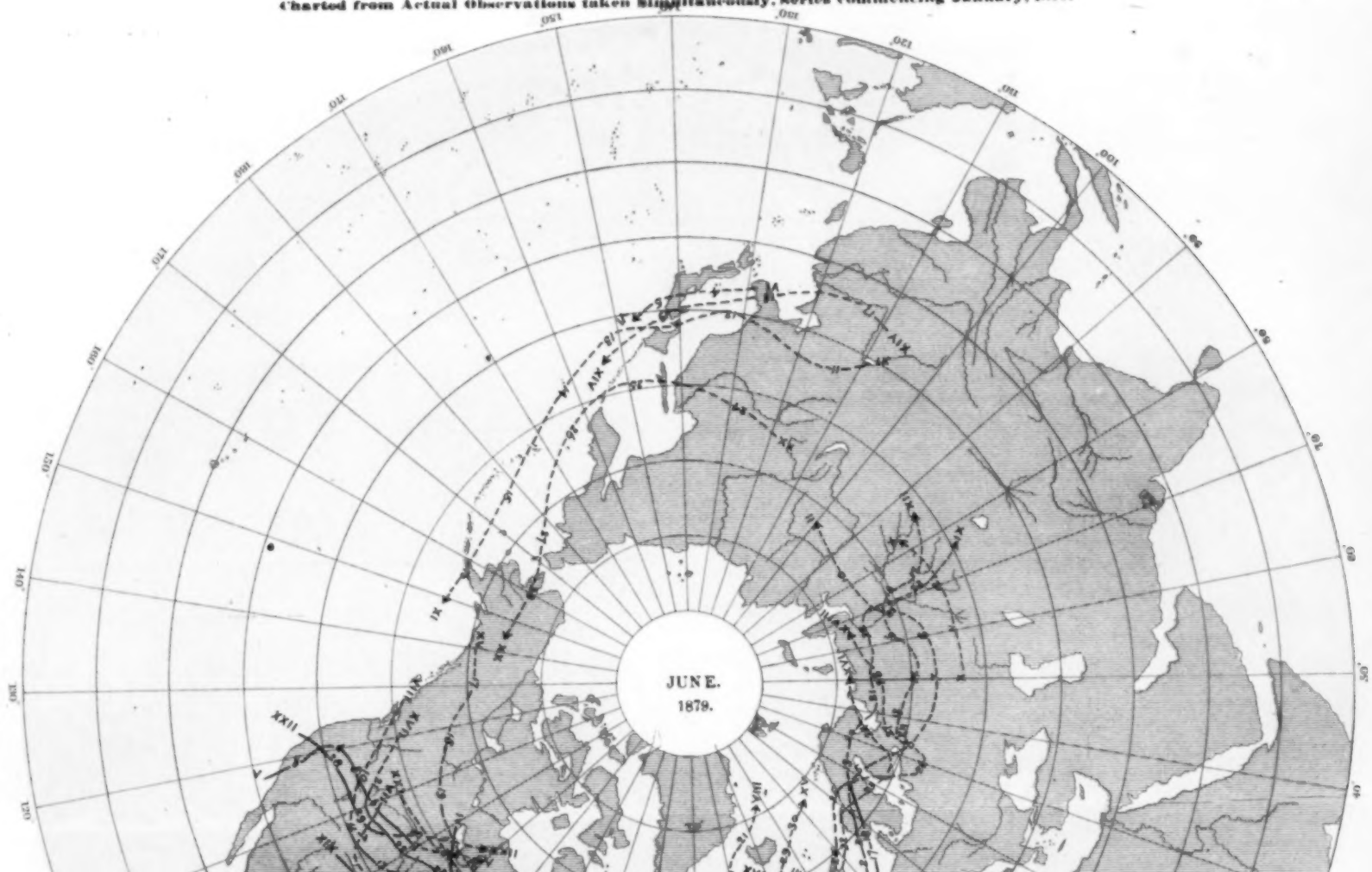
Showing mean pressure, mean temperature, mean force and prevailing direction of winds at 7:35 A. M., Washington mean time, for the month of June, 1873, based on the daily charts of the International Bulletin.

Office of the Chief Signal Officer.

UNITED STATES ARMY.

Charted from Actual Observations taken Simultaneously, Series commencing January, 1877.

No. VI.



PUBLISHED BY ORDER OF THE SECRETARY OF WAR

Storm-tracks in *Black*. The Arabic numerals show location of the centres of Low Barometer, at 7:35 A. M., Washington mean time, of that date.

Broken or dotted lines, are doubtful.

W. B. Hazen

Brig. & Bvt. Maj. Gen'l,
Chief Signal Officer, U. S. A.

INTERNATIONAL CHART.

Showing Tracks of Centres of Low Barometer for June, 1879.